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WHAT IS A FOREST?

By Frank A. Waugh

Amherst, Mass.

In America in modern times the word forest has come to have a very arbitrary and narrowly limited meaning. In the popular mind a forest is a tract of woodland where trees are grown for economic uses—that and nothing more. Even as regards the National Forests the common understanding does not include the idea of pasturage for cattle and sheep, nor the protection of city water supplies nor any of the hundred other utilities which are actually promoted by the Forest Service and which are of incalculable economic and social value.

This narrow, illogical popular misconception is frequently a serious handicap to forest legislation and administration. In our endeavors to make adequate plants for dealing with the exceedingly valuable recreation utilities in the National Forests we have met many practical difficulties growing out of this sole root of ignorance. Thousands of good people, and some of them professional foresters, simply cannot understand that fishing and camping and scenery are just as legitimate forest products as shakes and pulpwood and actually worth more at current market prices.

How this erroneous definition of forestry became established is a mystery. It has no historical foundation, either in law, in forest practice nor in common usage. It cannot be forgotten that the ancient rulers of Persia and Babylon established royal hunting forests. Possibly their predecessors in earlier dynasties did the same. Certainly whenever the first of these protected hunting grounds was proclaimed there the first national forest was established.

It would be an easy matter—more easy than profitable—to trace the history of forestry through early times, and especially through Roman law, to the present time. For us the main interest lies in English common law and in the usage of the mother tongue in respect to forests. In this field a few authoritative citations will be worth while. Let the first be from Townley, a recent English writer on forestry. He says:

"But the etymology of the word Forest has no connection with woods or woodland; it means a waste or large open space. The legal definition of a forest which prevailed from pre-Norman days until the days of Charles II is, according to Manwood's *Laws of the Forest,* first published in 1598:

'A certain territorie of wooddy grounds and fruitfull pasture, priviledged for wild beastts and foules of Forest Chase and Warren to rest and abide in, in the safe protection of the King, for his princely delight and pleasure, which territorie of ground, so priviledged, is meered and bounded with irremoueable markes, meres, and boundaries, wether knowen by matter of record or else by prescription.' "[1]

This work by Manwood I have not seen, but I have noted another interesting extract from it in Gilpin, as follows:[2]

"In those days it was a matter of little ceremony either to make or to enlarge a forest. Thus saith the law:

'It is allowed to our soverign lord the king, in respect of his continual care and labour for the preservation of the whole realm, among other privileges, this prerogative,—to have his places of recreation and pastime wheresoever he will appoint. For as it is at the liberty and pleasure of his grace to reserve the wild beasts and the game to himself for his only delight and pleasure, so he may also, at his will and pleasure, make a forest for them to abide in.' "

One of the most illuminating discussions of early forest law in England is given by Cox, from whom one is tempted to make extended extracts. Here is one paragraph:[3]

"(William) the Conqueror acquired, by right of conquest, not only the demesne lands of the Confessor and of the nobles who had opposed him, but also all the rights of the chase over great woodland or open stretches of both cultivated and uncultivated ground, where royal hunting rights had previously been exercised by Saxon or Danish kings. With William and his immediate successors the chase was a passion,

[1] Townley, "English Woodlands," page 1. London, 1910.

[2] Manwood, "On Forest Law" quoted in Gilpin, "Remarks in Forest Scenery," 2: 94, 1834.

[3] Cox, "The Royal Forests of England," page 5. London, 1905.

and hence a code of singularly harsh and burdensome 'forest' laws soon came into operation. The Conqueror took advantage of the autocratic position secured to him and his followers by their military success, to carry out 'afforestation' not only over the restricted areas that had been the hunting grounds of his predecessors on the throne, but over almost all the old folkland that remained unenclosed. The term 'forest,' that had been long in like use on parts of the Continent, was then introduced into England, and made to embrace vast districts, which included woodlands and wild wastes of moor, as well as patches of cultivated land. Within these afforested tracts, he decreed that the right of hunting was vested solely in the Crown, and could only be exercised by the king, or by those who were specially privileged under royal licence to share in it. The feudal idea about all wild animals, however monstrous and harsh in operation, possessed a rough logical basis. It was argued that all such animals were *bona vacantia*, or ownerless property, and hence pertained to the king; that hunting was essentially the pastime or 'game' of kings; and that therefore the right of exercising the chase, or taking all kinds of beasts of venery, belonged solely to the king."

The same writer explains further: [4]

"In some cases there were permanent forges of some size, belonging to the crown, within the forest bounds; of this there were two instances in Duffield Frith.

"In the Belper ward of Duffield Frith there was considerable surface coal mining; on Dartmoor and Exmoor there were particular regulations affecting the procuring of peat; whilst in other forests the quarrying of stone for building purposes, for millstones and for tombstones, as well as the burning of lime and digging of marl were pursued, but in all cases with due regard for non-disturbance of the deer. Such callings were confined to particular sites, as far as possible on the fringes of the forest.

"The following of trades that were obviously detrimental to the deer, through odour or otherwise, such as the tanning of hides, were rigorously prohibited within forest bounds."

The old English idea of the forest is summed up in the following definition: [5]

"Perhaps the following definition is as accurate a one as can be given in a few words, or what used to be understood by the English term 'forest' in Norman, Plantagenet, and early Tudor days. A forest was a portion of territory consisting of extensive waste lands, and including a certain amount of both woodland and pasture, circumscribed by defined metes and bounds, within which the right of hunting was re-

[4] Op. cit., page 8.
[5] Op. cit., page 1.

served exclusively to the king, and which was subject to a special code of laws administered by local as well as central ministers."

Next we may note another definition from another British authority, who says:

"The essential character of a forest, in legal and technical phrase, we have found to be its being a Royal hunting-ground."[6]

Choosing further and condensing from the same authority we gather the following data:[7]

"The first forest law in England was established by King Canute in 1016 A. D. It dealt chiefly with the establishment of courts for trying forest offences (i. e., poaching). Timber was considered valuable chiefly as it served to feed or protect game, especially the deer. Section 28 provided 'Let no one cut any of our wood, or underwood, without leave of the chief of the forest; which if anyone do, he shall be adjudged guilty of infringement of the royal chase.'

'Sec. 29. But if anyone shall cut down an oak or any tree that furnishes food for the beasts of the forest, beside infringement of the royal chase, he shall pay to the king twenty shillings.'"

Now the old English law and custom (and most of the technical forest terminology ran back to France. It is interesting therefore to take a glance at the early French ideas of forestry. One French writer, speaking of the period of Roman rule in France (just before the opening of the Christian era) remarks comprehensively: "The gallic-roman senators had no taste for the chase and were very little interested in forests."[8]

The most important forest legislation in France is found in the elaborate "Ordinance of 1669," which is said to have had a considerable influence on later legislation in many other countries. This comparatively modern instrument dealt with the French crown (national) forests in a manner recognizing other important utilities besides hunting and fishing, thus giving to royal recreation relatively a much smaller place than it had occupied in all earlier practice. Nevertheless Chapter XXX deals with "the chase" to the extent of 41 sections, and Chapter XXXI, "or fishings" requires 26 elaborate sections.

As compared with previous laws this ordinance was most liberal and humane. It abolished the penalties of death and mayhem formerly provided for poaching and similar forest offences; but it naturally fell

[6] Brown, "The Forests of England," page 35. Edinburgh, 1883.
[7] Ibid., page 208.
[8] Tessier, "L'Idee Forestiere dans l'Histoire," page 5. Paris, 1905.

something short of American ideas in 1922. The general trend and temper of the specifications may be fairly judged from one section, namely, Chapter XXX, section 28, reading as follows:

"We make it to be forbidden to merchants, artisans, burgesses, and inhabitants of the towns, burghs, parishes, villages, and hamlets, peasants and commoners, of whatever condition and rank they may be, not possessing fiefs, seigneuries, and high jurisdiction, to hunt in any place, or sort, or manner, any game whatsoever of fur or feather, under pain of a fine of a hundred livres for the first offence, of double that for the second, and for the third to be put three hours on a market day in the iron collar of their place of abode, and banished for three years from the Province of the Maitrise, without the judges having power on any account whatever to moderate the penalty, under pain of suspension." [9]

In this same work we find the following rather remarkable picture of French forest law: [10]

"In many of the older forest laws (of France) we find the terms, *Eaux, Bois et Forets,* used as if they constituted but one word—a word used commonly to designate in general the then existing jurisdiction in regard to all relating to fishing and to the chase, much as in English legislation the so-called Forest law is almost equivalent to what are now known as the game laws of the country."

Finally we may consider a very modern American summary of the English idea:

"In early English law the word 'forest' was applied exclusively to a tract of land composed entirely of a wooded area or of both woods and pastures that was kept as a refuge or breeding place for wild beasts and fowls, and within which the sovereign or other political dignitary enjoyed exclusive privileges for recreation and hunting." [11]

These citations might be multiplied into the hundreds. Without exception all examinations of the records will show that the early idea of a forest was that of a game cover, a place where wild game was harbored, especially for the recreation of royal sportsmen. In short recreation is the very oldest forest utility and historically the only one.

In this country the lay members have been trying with great earnestness and futility to draw a distinction between forests and parks on precisely this line. That is, the common newspaper mind has been trying to think of a forest as a stand of timber destined for lumber and

[9] Brown, "French Forest Ordinance of 1669," page 165. Edinburgh, 1883.
[10] Op. cit., page 52.
[11] Kinney, "Essentials of American Timber Law," page 14. New York, 1917.

of a park as a tract used for recreation. The most serious difficulty with these definitions lies in the fact that enormous areas of woodland are used for both purposes. Also both definitions go to pieces when examined in the light of historic usage.

To make a definition which will conform to actual facts in the United States of today, and which will interpret these facts reasonably in the light of history, we might say that a forest is any tract of land, usually characterized by a predominant growth of trees, maintained and managed for various human utilities.

This definition will bear explanation by saying that any one or several of these utilities may be held in view in the same area and at the same time. Some of the well known utilities of the present day are the following:

1. Production of timber for lumber, woodpulp, etc.
2. Production of resin, turpentine, and similar forest products.
3. Protection of water-supply for community use.
4. Protection of streamflow on account of commerce, manufacturing, and agriculture.
5. Grazing.
6. Recreation, including the protection of scenery, of fish and game, and of antiquities.
7. Protection of health—a utility not yet generally recognized but destined to play a large role in the forest policy of the future.
8. Amelioration of climate—a service for which the forests do not yet get full credit.

It is not desired at this time to follow further the suggested confusion of popular ideas in respect to parks. A basis of discrimination between forests and parks in matters of public policy has already been suggested by the present writer.[12]

[12] Waugh, "A National Park Policy," The Science Monthly, 6: 305, April, 1918.

WEATHER RECORDS AT LOOKOUT STATIONS IN NORTHERN IDAHO

By J. A. Larsen

Forest Examiner, U. S. Forest Service

Records which furnish information regarding weather conditions on mountains have always been of interest to the public and to scientists. To the U. S. Forest Service these are of great use in constructing the ground work for better forest fire protection. Students of climate, botany, ecology, and animal life are always eager for such data.

The tables given below have been prepared from records of air temperature, relative humidity and air movement at Forest Service fire lookouts in northern Idaho during the summer of 1919. The instruments used are standard maximum and minimum thermometers of the U. S. Weather Bureau pattern, the Robinson anemometers and sling psychrometers. The thermometer shelters were improvised from wooden boxes placed at regular height above the ground and oriented so that the instruments were shaded from the sun at all times. The instruments at the Experiment Station lookout were housed in a regular Weather Bureau shelter. The data for the lower stations with which the mountain records are compared, are supplied by the U. S. Weather Bureau Co-operative Stations at Wallace, Kooskia, Spokane and Priest River Forest Experiment Station.

The lookout points at which these records were taken are as follows:

Lookout	National Forest	Elevation, feet above sea	Observer
Coolwater	Selway	6,930	Gerald Gill
Monumental Buttes	St. Joe	6,979	Eugene Harpole
Sunset	Coeur d'Alene	6,424	Paul Wickward
Mt. Silcox	Cabinet	6,840	Louis F. Rosenthal
Experiment Station	Kaniksu	6,000	G. W. Simmons

The figures in Tables 1 and 2 represent fairly well the average air temperature conditions in northern Idaho during the warm and clear days which usually occur from the beginning of July until the middle of September.

TABLE 1.—*Air Temperature on Lookouts and at Low Stations, Summer 1919.* (Degrees F.)

Lookouts and co-operative stations	July			August			September			Dates missing
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	
Coolwater, elv. 6,930...	71.1	51.1	61.0	69.4	51.8	60.8	62.1	42.2	52.1	Sept. 21-30
Kooskia, elv. 1,261...	92.8	50.1	71.4	86.2	51.3	68.8	71.9	40.8	56.4	
Monumental Buttes, elv. 6,979...	71.3	47.2	59.2	72.6	49.1	60.8	59.9	39.5	49.7	Sept. 18-30
Wallace, elv. 2,770...	85.9	48.5	67.2	83.3	42.5	66.3	71.1	35.6	53.4	
Priest Rr. Experiment Sta. Lookt., elv. 6,000...	69.3	51.9	60.6	68.6	51.0	59.8	57.3	41.6	49.9	Aug. 5-12
Priest Rr. Experiment Station, elv. 2,300...	86.1	42.3	64.2	84.8	47.8	62.9	72.0	41.1	56.5	Sept. 20-30

TABLE 2.—*Diurnal March of Air Temperature on the Mountain and at the Valley Station, August, 1919.* (Degrees F.)

Location—Elevation	A. M.						P. M.					
	2	4	6	8	10	12 Noon	2	4	6	8	10	12
Valley, 2,300	42.7	40.4	39.5	50.4	C4.5	76.7	82.4	83.3	78.5	61.2	51.0	46.1
Mountain, 6,000	54.4	52.8	54.6	59.2	61.3	64.3	67.2	65.7	61.2	57.7	56.5	55.3

The data in Table 1 show that the maximum air temperatures are in every instance higher at the low than at the high stations; the differences vary from 10 to 17 degrees and in one case is as great as 21 degrees. The minima temperatures are in every case lower in the valleys than on the mountains, but the differences are not as pronounced

as in case of the maxima. They vary in most cases 2, 3, and 4 degrees and are not above 10 degrees. These inversions are no doubt due to the rise of the heated air from the valley land at night to higher levels and a simultaneous downward flow of cold air along the gulches and draws which settles over the low land. Naturally the greater horizontal air circulation on the mountains both day and night, brought out in Table 4, is also influential in equalizing the air temperature on the mountains.

Data on wind velocity for low stations are available for Spokane and Priest River Experiment Station. These are compared with air movement on the mountains in Table 3.

TABLE 3.—*Wind Movements on Lookout Stations, 1919 (except as otherwise noted.)*
(Miles per hour.)

Station and elevation	July		August		September		Dates missing
	Ave.	Max.[1]	Ave.	Max.	Ave.	Max.	
Coolwater, elv. 6,930	8.2	12.7	8.1	10.2	9.9	16.2	Sept. 21-30
Mounmental Buttes, elv. 6,979	13.0	28.6	15.0	29.6	15.5	27.5	July 1-7 Sept. 18-30
Sunset, elv, 6,424	9.6	15.9	10.2	14.9	12.6	21.5	
Mt. Silcox, elv. 6,840	[2]13.0 [3]12.7	18.8 26.7	11.5 20.0	23.1 38.0	12.4 14.3	21.6 31.0	July 1-12 Sept. 20-30 Sept. 24-30
Priest Rr. Experiment Sta., 6,000	9.5	16.1	8.9	14.3	10.6	22.4	Aug. 5-12 Sept. 20-30
Priest Rr. Experiment Sta., 2,300	3.5	5.6	3.1	4.7	2.8	4.4	
Spokane, Wash., elv. 1,943	5.9	27.	5.6	28.	5.3	30.	

[1] The highest for any one whole day. [2] 1917. [3] 1918.

The average daily wind velocities at the mountain stations are from two to three times that shown by the low stations and the maximum daily movement at Priest River Experiment Station conforms to this relation, but at Spokane the maxima are as great as those on the mountains. The explanation for this is most likely due to the fact that at the Experiment Station in northern Idaho the wind is obstructed

to some extent by the north and south trend of the mountains, but at Spokane the wind from all directions is less obstructed.

Comparative wind movement for different parts of the day for high and low stations are given in Table 4. On the mountain there is very little difference in movement by night and by day—only a slight increase in the afternoon—but in the valley the air is almost still at night and shows the maximum movement in the afternoon.

For comparison of the relative humidity at high and low stations it is necessary to have simultaneous observations. These are not always easy to obtain. Such records were taken at Priest River Experiment Station for 1917 and given in Table 4.

TABLE 4.—*Diurnal Changes in Wind Movement and Relative Humidity on the Mountain and in the Valley—Priest River Experiment Station, Summer, 1917.*

Time of observation	Location and elevation	July		August		September	
		Wind, mi. per hr.[1]	Relative humidity	Wind, mi. per hr.[1]	Relative humidity	Wind, mi. per hr.[1]	Relative humidity
			Per cent		*Per cent*		*Per cent*
8 a. m.	Mountain, 6,000	10.9	75	8.4	60	8.1	71
8 a. m.	Valley, 2,300	0.9	66	0.8	73	0.8	87
1 p. m.	Mountain	9.9	70	7.9	49	8.0	62
	Valley	3.6	32	3.1	26	2.5	47
5 p. m.	Mountain	11.4	65	9.7	46	7.3	56
	Valley	3.9	34	3.2	32	2.3	57

[1] Average movement between the hours of observation.

In keeping with the air temperature relations at high and low stations shown in Table 1 the relative humidity on the mountain is lower at night and greater during the day than at the low station. In August the air at 8 a. m. in the valley showed 13 per cent greater relative moisture than on the mountain; at 1 p. m. the valley air was already 23 per cent, and at 5 p. m. 14 per cent drier than on the mountain. These relations naturally depend upon the weather conditions; during rainy, cloudy or windy weather the differences in temperature, wind and humidity are less pronounced than in clear weather.

It is assumed that the extent or degree to which these variations take place will depend somewhat upon the general relation of mountains to plains or bodies of water and whether the land is barren or forested, and the position of the stations in relation to wind gaps or principal divides, but the data do not admit of such comparisons.

From a standpoint of forest fires these differences in weather condition at high and low stations in summer explain why the fires burn better at higher than at lower elevations at night. The greater air movement fans the flames, supplies more oxygen, and the higher temperature keeps the relative humidity lower so that there is less atmospheric moisture to dampen the dead needles and moss. The high air temperature and low humidity at lower elevations, during the afternoons produce more critical conditions than prevail on the mountains at this time of the day.

The mountain vegetation in this region probably works more energetically than that on the flats and at lower points, not only because of the longer hours of sunshine per day on the mountain, but also because of the more moderate temperatures at night. The greater transpiration which takes place at higher elevations on account of decreased atmospheric pressure and increased wind must be somewhat counterbalanced by the higher relative humidity which prevails on the mountain during the day.

The vegetation on the lower slopes and flats is more exposed to injury by frost at night and to severe drought by day than that on the mountain, but fortunately the air movement at the lower elevations in the afternoon is only about one-third as great as that on the mountain.

A NEW METHOD OF MEASURING TREE HEIGHTS ON SAMPLE PLOTS

By Hermann Krauch

Forest Examiner, U. S. Forest Service

The periodic examination of sample plots in District 3 involves the measurement of both diameter and height of each tree. Diameters are quickly and accurately taken with a diameter tape, but the measurement of heights is a difficult and slow process. The Forest Service standard hypsometer is used. The method followed up to the present time has been to measure off a hundred-foot horizontal distance and to take two readings; namely, that portion of the tree below the observer's eye and the part above. The two readings added give the total height of the tree. Or, if the observer stands so that his eye is below the base of the tree, the first reading—from eye level to base of tree—is subtracted from the top reading.

Investigations show that it is necessary to take all subsequent readings from the same or from nearly the same location as the original readings were taken.[1] In fact, trees have been found to record a shorter height five years subsequent to previous readings due to each measurement being taken from opposite directions. Since it is therefore necessary that height readings should always be taken from or near the same point, considerable time is involved in relocating such points each time that the plots are re-measured. The *exact* points cannot, of course, be relocated and it is therefore necessary to always duplicate the *two* readings for every tree, as described before. Dragging the 100-foot chain around to different points requires a tremendous amount of time and effort and to re-locate the former locations from which readings were taken, may be the cause for considerable error, considering the exact results desired in this kind of work.

In order to reduce the chance for error and at the same time make more rapid progress in re-measurement of tree heights possible, the

[1] See article by writer, "Some New Aspects Regarding the Use of the Forest Service Standard Hypsometer." Journal of Forestry, Vol. XVI, No. 7, November, 1918.

writer has devised the following method. When a sample plot has been laid out, choose points from which a maximum number of tree heights can be seen. It is not necessary that such a point should be exactly 100 feet, or a multiple distance thereof, away from each tree. This matter will be discussed later. Drive stakes at these points of observation and protect with rocks to reduce chance of their becoming dislodged or obliterated. As a further precaution tie each stake by distance and bearing to two or more trees. In case of loss, the exact location can thus be found again. Measure off the exact horizontal distances to all trees that can be reached from the same location and record next to corresponding tree numbers in note book. Then take the height readings with hypsometer or Abney level.[2] The readings obtained will not be the true values unless the observer happens to stand exactly 100 feet away. The true values are, however, readily computed by multiplying the readings from the instrument by the horizontal distance used and pointing off the product two places to the left. Thus a reading of 75 on the instrument, but taken 120 feet away, means that the tree is 75 by 120 = 90.00 feet high. At 100 feet away the reading on the instrument would also be the true reading; that is, 90 feet. Following is an example of tabulated results by this method:

Stake number	Tree number	Horizontal distance	Base reading	True measure	Top reading	True measure	Total true height of tree
1	1	150	+10	+15.0	60	90.0	105.0
	2	120	+15	+18.0	70	84.0	102.0
	3	90	+20	+18.0	80	72.0	90.0
	4	50	+20	+10.0	30	15.0	25.0
	5	60	+30	+18.0	40	24.0	42.0
	6	80	+20	+16.0	30	24.0	40.0
	7	75	—10	— 7.5	60	45.0	37.5
	8	50	+20	+10.0	40	20.0	30.0
	9	200	— 5	—10.0	60	120.0	110.0
	10	180	— 6	—10.0	50	90.0	79.2

[2] Where many trees can be read from a single point the improved Abney level is recommended. This instrument has a ball and socket joint attachment so that it can be mounted on a Jacob staff. The values are in per cents just the same as on the Forest Service standard hypsometer and can thus be used in the same manner. It has the further advantage of having a long barrel, thus enabling an accurate line of site and the scale is divided into two-foot sub-divisions, thereby making close interpolation possible.

The advantages claimed for this method of securing heights of trees on sample plots are:

1. Accuracy—because readings will always be taken from the same location, and since many trees are read from a single point the use of a precise instrument is warranted.

2. Speed—because, after the horizontal distances are once measured no further repetition of this phase of the work is required. Only the reading to the top of each tree is required after the original measurements have been made for the base reading remains the same.

NOTE.—Dr. J. V. Hofmann, of the Wind River Forest Experiment Station of the Forest Service, has used practically the same method for height measurements in permanent sample plots of Douglas fir. He substitutes, however, for the hypsometer a light mountain transit, which is set up over hubs at the selected points so that the settings can be exactly duplicated at subsequent measurements.

ANOTHER MINIMUM REQUIREMENT—REGULATION OF THE CUT

By Samuel T. Dana,

Forest Commissioner, State of Maine.

Since Colonel Graves, nearly three year ago, fired the opening gun in the campaign to secure public control of private forests, the term "regulation" has echoed throughout the land. Discussion has waxed warm as to whether private owners in the handling of their forest properties should be regulated by the Nation, or regulated by the State, or whether indeed they should be regulated at all. Oddly enough, however, in all this discussion there has been hardly a reference to "regulation" in the technical sense so familiar to foresters.

According to the report of the Society's committee on Forest Terminology, forest regulation (or organization) means "the branch of forestry which concerns itself with the organization of a forest property for management and its maintenance, ordering in time and place the most advantageous use of the property, with the ultimate aim of securing a sustained yield;" and regulation of cut means "the fixation in advance of the annual or periodic cut, which in the normal forest would be equivalent to the annual growth." Yet this kind of regulation, whether mandatory or voluntary, is being practically ignored not only by the general public but even by foresters. Is this wise?

The Capper Report pointed out that we have some 81 million acres of once forested lands that are now almost wholly unproductive, and an additional 245 million acres that are only partially productive. Moreover, we are now cutting or destroying each year four and a half times as much timber as is grown, and even in second growth stands the annual cut is considerably in excess of the annual growth. In other words, our forests are steadily decreasing in area, growing stock, and annual production. As a basis for recommending concrete measures to meet this situation, the Forest Service has initiated a "minimum requirements" study which, both by its title and its definition of continuous forest production, is limited to a consideration of protection and silviculture. Probably few will question that this study, even

with its comparatively limited scope, is well worth while. It should be effective in indicating steps which should be taken to prevent forest denudation and in establishing the need for further investigations. It does, however, carry with in the very real danger that the *minimum* character of the study will be overlooked, and that its results will be regarded as more comprehensive and conclusive than they really are.

Already we hear persons in high places, both foresters and others, saying that fire protection is all there is to the problem, that if fire is kept out the forests will take care of themselves. This is not true. Even the statement that fire protection is 75 per cent of the problem is misleading, since it is too apt to convey the impression that by "the problem" is meant the practice of forestry. Fire protection is, of course, fundamental, just as it is fundamental to farming or manufacturing. But it is far from being all there is to forestry. If it were, forestry would be a mere trade and men would be fools to waste four or five years in technical preparation for it.

It is also misleading to say, as a prominent educator recently did to me, that "silviculture *is* forestry. You can't get away from that." Silviculture undoubtedly goes many steps farther than fire protection. It may secure more and better natural reproduction, it may artificially reforest waste areas, and it may improve the stand after it is once established. But it will not protect the forests from insects and disease, nor will it secure a sustained yield. Neither will it solve the multitude of problems involved in forest and wood utilization and forest economics. All of these are an integral part of forestry, but their consideration at this time would take us too far afield.

The point which should be emphasized is that in order to obtain really continuous forest production, regulation of the cut so as to secure a sustained yield is essential. In no other way can continuity of the forest and wood-using industries, about which so much concern is manifested nowadays, be insured. The problem of furnishing this country with an adequate and continuous supply of wood will not be solved until its forests, both nationally and locally, are so organized and managed that the annual cut is approximately equal to the annual growth.

Pennsylvania and the Lake States are frequently held up as horrible examples of forest devastation. Attention is called to the economic evils, such as the decay of agriculture, the migration of the forest and wood-using industries, and the consequent decline of previously pros-

perous villages, which have followed the destruction of the forests. This is all true enough. But suppose that the lumbermen of those days had had the benefits of the minimum silvicultural and protection requirements study now under way. Suppose that they had applied the results of that study, either voluntarily or under pressure, in their cutting operations, but without altering appreciably the rate at which the timber was removed. Suppose that reasonably satisfactory reproduction had resulted from these operations. How effective would this have been in maintaining the prosperity of those regions? Hardly at all.

Industries migrated and villages disappeared because there was no more merchantable timber to cut, not because reproduction was lacking. The most perfect reproduction in the world would not have kept the sawmills running or the woods labor employed. If Michigan's barren sand plains had been fully restocked when the virgin stand was removed, the State would of course be far better off today; but it would not have escaped a period of depression almost as serious as that which it actually experienced, while waiting for the young growth to attain merchantable size. If the "Pennsylvania desert" had been reclothed with pine and hemlock instead of with scrub oak and fire cherry, the State might still be importing nearly four-fifths of its timber requirements. Certainly that classic example of the deserted lumber village—Cross Creek—would have trod the same path that it actually did; for the disappearance of the merchantable timber, even though succeeded by young growth, would have left it without means of support.

It is useless to expect any region or locality primarily valuable because of its forest resources to continue prosperous if these are consistently overcut. It is inadequate to attempt to meet a situation where we are using each year four and a half times as much timber as we grow by prescribing fire protection and silviculture. These are both good; the more of them the better. But in doing away with "slacker acres" they will not solve our forest problem. The alternate ups and downs and the periodic migrations that have so far characterized the history of the lumber industry will be avoided and real continuity of local supplies and local industries assured, only by organizing our forests on a business basis for sustained yield. The mere fact that a region is coming up to young growth will not prevent its abandonment after the merchantable timber is gone, with the necessity of painfully re-

building in another generation or two the industries that might have remained in continuous operation had the forests been properly managed.

Objection will doubtless be raised that forest regulation, while all right in theory, is at present economically impracticable. Even if this is true, it does not relieve our profession from the duty of emphasizing the importance of this branch of forestry and of urging its practice as rapidly as possible. It is, however, doubtful how much real weight there is to this objection. Kirkland, who is a pioneer in this field, and whose voice has been crying practically alone in the wilderness, claims that the most profitable time to place forests on a sustained yield basis is while stumpage is still cheap; in other words, since stumpage is constantly rising, the sooner the better.

In addition to stabilizing industry, the general introduction of forest management would bring with it many advantages to the individual owner as well as to the community. Most important of all, perhaps, it would do away with the annual depletion charge which now constitutes such a heavy burden on the industry and which is necessitated solely by the fact that the forest is treated as a mine rather than a crop. By insuring an annual return it would do away with the compound interest charges which must be met when forest practice is started with the bare land or even with a young growth unaccompanied by merchantable timber, and which so frequently cause all forestry to be regarded as impracticable. Minor advantages include the decreased cost of capital and the reduced costs of competition and over-equipment which would result from placing the industry on a non-speculative and permanent basis.

As a matter of fact the question is not so much whether the country can yet afford to practice forest regulation as whether it can afford not to.

Another important consideration is that forest regulation carries with it almost automatically both protection and silviculture. No forest owner, public or private, is going to organize his property on a sustained yield basis without seeing to it that losses from fire, insects, and disease are reduced to a minimum, and that cutting is so done as to secure a satisfactory reproduction of desirable species. If regulation of the cut could be brought about, no matter how, it would immediately establish forest production on a sound and comprehensive basis.

While the net gain from such regulation would be tremendous, there are two possible disadvantages that should perhaps be noted: It might work a hardship on those owners and operators who are now overcutting and who at the same time are so situated that they cannot afford to reduce their cut; and it might temporarily raise somewhat the price of forest products. The first of these effects would be strictly comparable to the hardship resulting from the reduced cut not infrequently necessitated even now by economic conditions. The only difference would be in the substitution of a definite plan for lack of plan in bringing about the reduction. It would also be comparable to the situation in which a farmer finds himself when poor crops result in smaller returns than had been anticipated. With farm crops the annual use is automatically adjusted to equal the annual growth, with the exception of minor variations due to storage. With forest crops, because of the long period required for them to mature, it is possible by allowing the forest capital to accumulate to harvest many years' growth in one. This necessitates the use of foresight in forest management, and gives rise to the art of forest regulation which is peculiar to forestry and has no counterpart in farming.

As to the second effect, that of increased prices, this would be a purely temporary phenomenon. It is the penalty which the community must pay for having squandered one of its basic resources, until such time as it can get back to normal. Moreover, the slightly higher prices that might have to be paid during this transition period while forest production is being brought up to normal would be insignificant compared to the much higher prices that would presently have to be paid if timber depletion were allowed to proceed unchecked. That in the long run it would be to the advantage of the country in general and of the industries in particular to place our forests on a sustained yield basis as rapidly as possible, can hardly be doubted.

By all means let us formulate effective minimum silvicultural and protection requirements. But let us not fool ourselves or the public into thinking that these, no matter how generally applied, will solve our forest problem. We must look forward to moving beyond this minimum just as rapidly as possible. We must also look forward to establishing another minimum requirement in the field of forest regulation. Foresters owe it to themselves and to the public to emphasize more strongly the fact that regulation of the cut, whether voluntary or mandatory, is an integral and highly essential part of forestry.

MINIMUM SILVICULTURAL AND PROTECTIVE REQUIREMENTS FROM THE STANDPOINT OF THE TIMBERLAND OWNER[1]

By W. J. Damtoft

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The assumption is that the study of minimum silvicultural and protective requirements is for the purpose of evolving the simplest systems of management for the various forest types which will assure a future stand of any character whatsoever provided only it be a commercial stand. In other words, it is to discover the path of "least resistance" which will lead to sustained yield.

What has prompted the Government to initiate this study? Has it been the recognition of the fact that the most that can be hoped for in the next few years from the timberland owner is an interest in the simplest and least expensive systems of management or has it been prompted by recognition of the fact that, even though the timberland owner is willing to go the limit, the existing knowledge on the part of foresters is too limited to attempt at this time to evolve the more refined silvicultural systems planned to secure future stands of maximum quantity and yield? These are the two facts which suggest themselves to the speaker. Both of them appear to be sound and either one of them is probably justification enough for the institution of the study.

Conditions are not such today that the private timberland owner can be expected to consider more than the simplest and least expensive systems of forest management. In the first place he has just within the last few years come to take any interest whatsoever in conservation or forestry in general and is therefore not yet able to assimilate heavy doses of forestry medicine. To attempt to force on him at this time highly complicated and involved systems would result probably in completely discouraging him and in killing what little enthusiasm he might already have. He must be led to his ultimate destination step by step and not hurried to it, especially as he is not entirely sure of that destination nor entirely keen in his desire to reach it. Then again existing

[1] Delivered before Southern Appalachian Section of the Society of American Foresters at Asheville, N. C., October 29, 1921.

conditions are not conducive to the consideration of the highly intensive, or what might be called advance, systems which, though promising of highly satisfactory results are not certain of producing them. There is to be sure an alarming continuing decrease of our timber supply but is it at present really apparent enough to have a strong psychological effect on those who are inclined to minimize this decrease or even to deny it? It must be remember that most people give little consideration to conserving supplies until their larders reach such a low stage as to make a visible effect on them. Unfortunately they are not readily moved to concern by figures, especially those compiled by others.

Now, one who is primarily a student of forestry and who makes careful analyses of conditions may argue that the existing conditions not only do not justify the attitude which has here been attributed to the timberland owner but, on the contrary, make imperative immediate attention to the application of intensive forestry. Undoubtedly this is true, but when we consider the average timberland owner we are considering an individual who is more intimately concerned with the present "dollars and cents" returns on his timber than with future yields.

In making this statement it is not meant to infer that because of this consideration for immediate returns the timberland owner is entirely indifferent to the demands of the public or without one iota of interest in the pressing problems of forest conservation. Just crediting him with average intelligence it would be folly to assume that he could take such a position in view of the fact that practically all peoples today are brought to face facts and figures which cannot but somewhat impress upon them the danger that lies before the country from a complete lack of attention to these problems. Probably, on the contrary, the average timberland owner is slightly above the average in intelligence and gives at least equal consideration to figures and reports as the average citizen. This is natural to assume from the very fact that he has prospered sufficiently to become a land owner. It is believed that he has even developed sufficient interest to seriously consider the adoption of some systems of management for his timberlands provided they are inexpensive and simple in their application. This belief is occasioned by the tone of the press of all wood using industries. Again the large amount of support which has been given the Snell Bill indicates the existence of considerable interest. On the other hand, that this interest has its bounds is indicated by the violent opposition to the radical Capper Bill.

And perhaps it is well that interest is limited, for were it too greatly developed it is feared that the professional foresters of the country would often be highly embarassed by the problems which would be put to them. It is the belief of the speaker that there does not exist today that forester who has had experience or observation enough to enable him to advise the best methods of handling the many forest types of the Southern Appalachians to secure maximum future results. There may be some who have highly developed theories calculated to meet all existing conditions and are strong in their convictions as to the practical results which they will achieve, but it has not been the fortune of many of us, I'm sure, to have met up with them. It may be true that in some forest regions of the country the problems are not nearly as intricate as here and that the students of them can speak with the greatest conviction. This is likely the condition in many foreign countries. Edward Beck, representative of the Canadian Pulp and Paper Association, states in his report on Forestry Conditions in Sweden, Finland, Norway, Great Britain, and France, "It is difficult to conceive of a body of Swedish foresters, for instance, sitting down to discuss seriously some of the, to them, elemental questions concerning methods of conservation and cutting such as still engage the forestry minds of other lands." I believe we are one of those *other* lands.

Let us take, for example, the situation in connection with one of the largest timberland owners of this section. There are represented on his holdings almost all the forest types peculiar to the Appalachian region. There is in his employ a forester—whose ignorance it is hoped the owner does not entirely recognize. This forester has most of the time since entering upon the active practice of his profession been connected with the "fist and skull" branches of it than with the more highly technical phases and has been during the greater part of the time in the "sticks" and away from association with those who have been engaged in the investigative and more theoretical branches of the profession. This he has often assumed as one of the excuses for his ignorance, and yet it occurs that instead of being an excuse it is perhaps a fact which should make him a better judge of the possibility of application of the theories with which he is familiar and of the practical results to be expected from these theories. He has found when attempting to judge of the best manner of handling a particular forest type that there occur to him several methods the results of any one of which can be surmised but not accurately judged. He has never as yet finally

determined upon any particular system for any particular type and has called upon others for assistance. He has had the benefit of consultation on the ground with men whose knowledge of the theory of forestry can probably not be surpassed, they having given most of their time to work of investigative nature. And yet it has been apparent that they also, although entertaining numerous theories, are not entirely convinced as to the ultimate results of the application of any of them.

Now then, the question arises, does this uncertainty on the part of professional foresters entirely discourage the timberland owner? No; on the contrary, it only makes him realize the more the great existing need for further studies and investigations. And undoubtedly this owner is representative of most progressive timberland owners of today. This is certainly indicated by the discussions which take place at all meetings where owners are represented and by the press of wood using industries.

It cannot be hoped to secure the results of any studies until a very long period has elapsed, and the more intensive the results which it is hoped to obtain the greater the period will be. Inasmuch as every delay in the instituting of any definite system aimed at conserving the timber supply of the country means further depletion of this resource the sooner some system is instituted the less probability there will be of this depletion reaching the point that will make the application of any system entirely useless. Therefore, in order to reduce the delay to as short a period as possible it were better to begin the studies with those methods of management which might be termed the less intensive ones; in other words, those aimed at fulfilling the minimum silvicultural requirements of the different forest types.

It is fully believed that the favor shown by the timberland owners to the Snell Bill as contrasted to their antagonism toward the Capper Bill indicates clearly the extent of the owners' present attitude toward forestry. It indicates fully that they are considerably concerned with the forest problem which confronts the country today but are very much adverse to having to take upon themselves too large a share in solving this problem. They feel that they can well be expected to go part way in meeting a situation which is the concern of the whole public but should not be made to shoulder the full responsibility. They might possibly in a few years be willing to go to the extent of applying to their lands those methods of conservation the results of which are a certainty, and this probably only upon condition that the public help to

defray the expense of these methods. They certainly will not, and cannot well be expected to, apply methods the results of which are entirely uncertain as is true today particularly of the more intensive methods. The timberland owner undoubtedly fears that under so radical a bill as that introduced by Senator Capper there is probability that he will be forced to apply these more intensive methods, and very likely the antagonism to this bill is prompted far more by this fear than by a disinclination to aid in conserving the country's timber supply.

The day is coming when it will be clearly apparent that this country must of necessity apply the more intensive forestry methods. It is then that such legislation as proposed in the Capper Bill will be more readily accepted; and undoubtedly by that time because of the studies now being instituted there will be sufficient information to allow of the intelligent application of the provisions of such a bill. Until this day arrives the timberland owner can at least be expected to do his utmost to aid in determining those methods of managing his lands which will at least maintain on them a forest cover of trees of economic importance. He will do this if he gives wholehearted, aggressive co-operation to the Government and State forest officers in the carrying out of their studies of minimum silvicultural and protection requirements.

This co-operation should not merely be between individuals of the timberland owners and those conducting the studies and only at sporadic intervals when specific request is made to the timberland owner—but should take the form of aggressive, permanent co-operation between timberland owners collectively and Government and State agencies collectively. This should be done not only to facilitate the studies of these public agencies and to secure maximum efficiency in their work but also as a matter of self-protection to the timberland owner. It is very true, as Captain Eldridge stated before the Appalachian Logging Congress at Knoxville, that if the timberland owners do not begin to take an active and collective interest in Government activities they will some day be subject to legislation in the making of which they have had no voice. Now is the time for them to begin to make that voice heard, to make known their ideas about those studies which may some day form the bases for legislation. Their opportunity is at hand, not to criticise, but to co-operate in solving vital problems, problems which mean much to the future prosperity and safety of the nation.

HUMUS AND ROOT SYSTEMS IN CERTAIN NORTHEASTERN FORESTS IN RELATION TO REPRODUCTION AND COMPETITION *

By Barrington Moore

FOREST TYPES

The principal northeastern forest types of commercial importance are well represented on Mt. Desert Island, Maine, and offer unusual opportunities for study. Since these types have already been described,[1] it is sufficient to say that there are stands of: (1) Spruce, sometimes nearly pure red spruce, sometimes a mixture of the red and white spruce, generally with a small percentage of balsam fir. This occurs both as spruce flats and spruce slopes.[2] (2) Hardwoods and spruce, that is, beech, yellow birch, sugar maple and red spruce this is Hawley and Hawes hardwood type (p. 208) and Murphy's mixed hardwoods.[3] (3) White pine, some pure stands, but mostly with varying proportions of red spruce, balsam fir (chiefly in the understory), white cedar (arborvitæ), red pine, white birch, gray birch, red oak (*Quercus borealis* Michx.f.), red maple, and others. (4) Pure white cedar in moist flats. (5) Pure pitch pine, similar in many respects, even in its understory plants, to the pine barrens of New Jersey and Long Island. These types are all perpetuating themselves naturally, except that possibly the white pine may be succeeded by a stand with

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* Read before the Forestry Section of the American Association for the Advancement of Science, Dec. 28, 1921.

[1] Moore, Barrington. "Some Factors Influencing the Reproduction of Red Spruce, Spruce, Balsam Fir, and White Pine." Journal of Forestry, Vol. XV, No. 7, pp. 827-853, 1917.

A fuller, though by no means complete, acquaintance with the island would modify certain parts of these descriptions. The types are better defined than the statement on p. 831 would imply. There is more pure white pine than had been supposed (p. 833). There is more than "a small patch" of spruce and northern hardwoods (p. 838). White spruce (*Picea canandensis*) is much more abundant and widely distributed than stated on p. 831.

[2] Hawley, R. C. and Hawes, A. F. "Forestry in New England." Pp. 206 and 209. John Wiley & Sons, N. Y. 1912.

[3] Murphy, Louis F. "Red Spruce; Its Growth and Management." P. 13. U. S. Dept. Agr. Bull. 544. 1917.

more spruce and fir, or more red oak. The dominant trees of the island, except on recent burns, are white pine, red spruce and white spruce, the three most valuable species in the northeast. The pitch pine type is not treated, except incidentally, in this paper.

SOIL AND HUMUS

Mt. Desert Island is characterized by bold relief and varied physiography. Glaciers and partial submergence beneath the seas have swept a large proportion of the island clear of soil, leaving parts with a mantle of till, a few deposits of rocky gravel and sand, and some pockets of clay.[4] On the whole, most of the island is composed of rock, principally pink granite cut across by occasional trap dikes, and brown stony till. The rock is not confined to the hills, many ledges destitute of soil being found on the more level parts of the island.

Most of the surface, both of the rock and of the till, except where burned, is covered with a layer of humus, commonly known as duff or raw humus. This is poorly disintegrated and composed chiefly of coniferous needles and litter except in the hardwood type where decomposition appears to be less slow, not, however, on account of the leaves themselves. This difference will be discussed more fully below. On practically all natural sites the duff forms a separate and distinct blanket, not mixed with the underlying soil. There are exceptions in that certain gravel and sand deposits, cedar swamps, and to a certain extent the hardwood type have some mixture of humus in the mineral soil; but even on these sites there is also a considerable surface layer of humus. The importance of this blanket of duff and of its separation from the mineral soil will be evident in the consideration of root systems later on.

Soil

The contact between the humus layer and soil is almost everywhere marked by a characteristic ashy grey layer of mineral matter, quite different from the underlying soil. This grey material appears to be more strongly developed on granitic soils, though it is also unusual on the brown glacial till and even on gravel. It is no doubt the

[4] Shaler, N. S. "Geology of Mt. Desert Island." U. S. Geol. Survey, 8th Annual Report of the Director. 1889.

Davis, W. M. "An Outline of the Geology of Mt. Desert" in Rand and Redfield "Flora of Mt. Desert, Maine." Pp. 43-71. John Wilson & Son, Cambridge. 1894. A brief summary of the geology and soil of the island is given on pp. 828-830 of the paper cited in footnote 1.

result of leaching by the water which has passed through the acid humus, in the manner described by Hilgard.[5] He says: "These acids act strongly upon the more readily decomposable silicates of the soil, and in the course of time may dissolve out, and aid in the removal by leaching of most of the plant food ingredients as well as the ferric hydrate of a soil. Thus rust or red colored soils may be rendered almost white . . . " which is exactly the case here, and " . . . almost wholly destitute of mineral plant food." The infertility of this kind of soil has been shown by the poor growth of wheat seedlings in making wilting coefficient determinations. It is also rather acid, most of it having a specific acidity of 100 (PH. 5.0) by the Wherry test;[6] infrequently is it found as low as specific acidity 10 (PH. 6.0).

The reddish brown mineral soil of the glacial till is a fine to medium clayey sand, generally filled with stones and boulders. Some of the smaller particles or silt, on the average about 10 to 20 per cent of the mass, settle rather quickly, while the finer material stays in suspension for a considerable time. This soil runs from a specific acidity of 3 + (PH. 6.5) to 30 (PH. 5.5), in exceptional cases up to 100. The wilting coefficient is approximately 7 per cent, the moisture holding capacity at saturation, by the Hilgard method,[7] is 61.3 per cent on the basis of volume. It is very infertile. In its original condition ordinary field crops, such as corn, wheat and clover, make but little growth on it. Spruce and fir, and to a less extent white pine, seem unable to develop good root systems in it. (See table on p. 846, and Figs. 3 and 4, pp. 847 and 848 of paper cited in footnote 1.) The most reasonable explanation of this infertility is probably not the acidity, since the poor growth shown in the curves was on soil of low acidity, only 3 +, but lack of nitrogen, unavailability of nutrients, and possible an unduly large amount of iron. It is significant that this soil contains comparatively few feeding roots of any kind. Anchorage roots penetrate it, but appear to run up through it to the humus above.

Some of the clay is grey and appears to be extremely infertile. On the kind tested it was impossible to grow wheat seedlings for wilting coefficient determinations. The indications from its moisture-holding capacity, which is only 55 per cent on the basis of volume, and

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[5] Hilgard, E. W. "Soils." P. 126. Macmillan Co., New York. 1912.

[6] Wherry, E. T. "Soil Acidity and a Field Method for Its Measurement." Ecology, Vol. I, No. 3, pp. 160-173. 1920.

[7] Loc. cit., footnote 3, pp. 208-209.

its rapid absorption of water, are that this not a true clay, but a very fine silt, or a glacial "rock flour." Yet it hardens and cracks on drying like a clay. Its reaction is 3 + acidity. There is also a blue marl which was not studied except as to reaction which is neutral.

Coniferous Humus

Humus formed by coniferous stands differs to a certain extent with the forest type, and with the density of the crown cover. Under full spruce canopies, and to a less extent under thick white pine crowns, there is what might be termed the grey or dry duff, varying from two centimeters in depth in young stands to twenty or more at the base of mature trees and in rock crevices; ordinarily it is about twelve. This is bare of surface vegetation or practically so, is usually greyish colored, and is poorly disintegrated for a considerable depth. Under spruce it is matted with the fine fibrous feeding rootlets of this tree. Toward the bottom where it comes in contact with the mineral soil it looks like a grey powder. The grey color is due to two causes. It comes primarily from dryness, for upon thorough wetting, the color becomes almost indistinguishable from that of the ordinary humus. The reasons for this dryness will be considered below. Part of the color is due sometimes, probably often, to the inclusion of layers of moss which grew before the shade became so heavy, and has since been buried under the dead needles and litter. Moss, bleached almost white, has been found structurally intact at a depth of more than five centimeters in the humus under spruce.

The grey duff shows the highest acidity of any vegetable matter tested. The concentrated extract pressed out after the material has been thoroughly soaked is very turbid, rather syrupy and seems to have a high colloidal content. Its reaction is Wherry's specific acidity 300 + to 1,000 (PH. 4.5 to 4.0), probably in the neighborhood of 500 or over, 6.8. This high acidity is important for vegetation, but represents an effect rather than a cause of the properties of this material.

Moisture conditions in this grey duff are probably the most important factor in its relation to reproduction and to the growth of shrubs and herbs. Contrary to the commonly accepted explanation, the absence of vegetation here is due more to dryness than to shade. Tests of the moisture-holding capacity by Hilgard's method show that it will hold from 400 to 500, sometimes even more than 600, per cent of its air-dry weight, and from 80 to 90 per cent of its volume. But it takes up this large amount of water with extreme slowness. In

the Hilgard cylinder it took more than three days for a layer of only one centimeter to soak up the water in which it was standing. In nature it probably seldom reaches its moisture capacity. It has been found dry to the touch even at the beginning of the growing season.

The chief cause of the lack of moisture is interception of precipitation by the tree crowns. Horton [9] has shown that the amount which tree crowns cut off ranges "from 100 per cent where the rainfall does not exceed the storage interception capacity to about 25 per cent as an average constant rate for most trees in heavy showers of long duration." He found that the average of 11 trees throughout one summer to be 40 per cent. Unquestionably the interception for spruce would be higher on account of its dense crown.

That shade is less important than dryness in preventing reproduction on these sites is indicated by patches of grey duff, bare of vegetation, under the crowns of spruces, and to a less extent of white pines, which are surrounded only by birches and other trees casting little shade. Here the light is much higher than in many of the small openings in the forest where reproduction is abundant. Conversely, under the dense shade of a full canopy moist spots will be found on which the humus is dark colored and covered with vegetation in spite of the shade.

Expressed in terms of moisture content, the grey duff under spruce crowns was found to have 20.5 per cent on the basis of air dry weight, as against 59 per cent for the humus of the openings.[10] The wilting coefficient in coniferous humus is high, approximately 35 per cent on the basis of air dry weight (40 per cent on the oven dry basis) so the humus under the crowns with only 20.5 per cent of water had no available moisture.

A further cause of dryness under coniferous trees is that the surface layer of needles acts like a thatch roof in checking the penetration of water. Murphy [11] speaks of hardwood leaves shedding water, but needles seem to be about as effective. Even after heavy storms in the autumn, when the woods appeared thoroughly soaked, there were numerous spots where the surface was wet from 3 to 6 millimeters down (generally about 3 mm.) and beneath this layer the grey humus was powder dry.

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[9] Horton, R. E. Monthly Weather Review, Vol. 47, pp. 603-623, 1917. Reviewed by C. F. Brooks, in "Rainfall Interception by Trees and Crops." Science, N. S. Vol. 51, No. 1322, pp. 439-440. April 30, 1920.

[10] Loc. cit., footnote 1, pp. 851-852.

Though this layer of duff is practically bare of surface vegetation, it is none the less filled with feeding roots, chiefly of spruce. These roots are very densely matted, and must absorb considerable quantities of moisture during the growing season, taking about all that is received.

Given the interception of a large proportion of the precipitation by the tree crowns, the needle covering acting like a thatch roof in preventing the penetration of much that does reach the ground, and the absorbing mat of spruce rootlets, is it any wonder that the duff under a full canopy of spruce or pine is dry? This dryness may be a factor in the slowness of decomposition in addition to the influence of low temperature mentioned by Coville.[12]

The usual coniferous humus of the spruce and pine forests differs from the above described grey duff only in degree. It also is poorly disintegrated and rather highly acid, running from a specific acidity of 100 to 300+. Under spruce forests on rocky sites it is covered with moss, beneath which it resembles the grey duff except in color, being darker on account of greater moisture, and possible also containing a different fungous flora. The acidity here is 300+.

The next stage to the moss covered duff is the ordinary coniferous humus made up predominantly of needles, but with a varying admixture of shrub and herb remains. This class of material is fairly uniform in physical properties and in acidity. The wilting coefficient is about the same as that of the grey duff; the acidity is around 300, but often only 100. Water is absorbed slowly as with the grey duff, but to a less extent; for when once coniferous humus is moist, it takes up additional water rather readily. Of course, this humus can become very dry, as is abundantly shown by frequent forest fires.

How long it takes for the grey duff to turn into this ordinary humus after the stand has been opened up is not known for certain. But the change appears to be rather slow. An estimate based on very limited observations would be around 5 to 10 years or longer. Although the ground receives more moisture when the stand is opened, it becomes subject to more rapid evaporation, so the surface remains rather dry. Also, the seedlings will have to withstand higher rates of transpiration. It would, therefore, seem to be the part of good silviculture to open these stands as gradually as the logging method will permit.

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[11] Loc. cit., footnote 3, p. 17.

[12] Coville, F. V. "Experiments in Blueberry Culture." U. S. Dept. Agri. Bureau of Plant Industry, Bull. 193. 1910.

The humus of cedar swamps, though coniferous, is in a class by itself. It is a black, well decomposed, rather rich-looking muck, almost neutral in reaction. Here the distinction between humus and mineral soil is not so sharp, and there is much vegetable matter mixed with the upper soil. In some cases, however, the stratum of humus and roots may be more or less elevated, with water beneath and separating the humus from the inorganic material. The grey layer of acid-leached soil appears to be absent. Cedar is by no means confined to these swamps, being abundant in the ordinary humus with an acidity of 100. It has even been found on a granite boulder with no soil except vegetable matter and granite particles.

In the hardwood type (beech, birch, maple and spruce), the forest floor is covered with leaves, except in the immediate vicinity of spruce trees. The layer of leaves, even under a virgin stand, is considerably thinner and looser than in the coniferous types, due probably to more rapid decomposition. The rate of disintegration does not appear to be due to the character of the leaves themselves, for stands of beech, red oak, red maple, yellow birch, and spruce (predominantly deciduous forests but not the true beech-birch-maple-spruce type) have been found with thick densely matted layers of poorly disintegrated deciduous leaves. The controlling factors are probably to be found in the climatic conditions which make the type possible. Just what these are cannot at present be stated with certainty. But they appear to be connected with shelter from winds coming over the Arctic current which seem to favor the dominance of boreal vegetation on a considerable portion of the island. Moisture is doubtless important. Soil is here secondary, for that under the hardwood-spruce type is the same reddish brown till that is found elsewhere under pure spruce and other types. Although there is somewhat more admixture of humus with the underlying soil than in other types, there is a similar layer of ashy grey leached mineral matter. A larger proportion of feeding roots go into the inorganic soil than on the other types. The acidity is less than in the coniferous types, running between 30 and 100, though under individual spruce trees, or groups of spruces, it may rise to 300+.

Under conditions typified by Mt. Desert Island, and they are common throughout the northeastern coniferous forests, the humus is the main source of nutrients for tree growth. This probably holds for other regions as well, but is not so noticeable where the humus is mixed with

the mineral soil.[13] Here the fact is accentuated by the distinctness of the blanket of humus. At least 90 per cent of the absorbing roots of both conifers and broadleaf trees, except in the hardwood type, are in this humus layer; in the hardwood type, the percentage though less is still high. The mineral soil and rock crevices furnish anchorage, and, to a certain extent water, but on the whole play a distinctly subordinate part in growth. Of course, after an area has been cleared for cultivation and abandoned, the mineral soil serves for the growth of the "old field" trees. But this is a different matter; the soil has then been changed through tillage, it has lost its "rawness," and the humus has become incorporated with the soil.

After a severe fire which burns off the duff it is probable that the ashes give a temporary fertility which permits the growth of herbs. shrubs and light seeded trees such as birch and aspen. These plants contribute organic matter which gives the conifers a chance to grow, to build up their own humus and eventually to restore the surface covering on which they depend.

ROOT SYSTEMS

A knowledge of root systems is important not only in planting, but in securing natural reproduction. The ability of a species to maintain itself on a given site, or to invade other sites, will depend largely upon its root habit in the juvenile stages. Its rate of growth, ability to compete with its associates, and wind-firmness will depend upon its more mature form and on the distribution of its feeding roots. In the younger stages it has, generally speaking, only feeding roots; in the latter stage, it has anchorage roots as well.

Juvenile Form

The great abundance on this island of seedlings of the more important coniferous species, white pine, red spruce, white spruce, balsam fir, and white cedar (arborvitae) affords an unusual opportunity for studying juvenile root systems under natural conditions. There is also ample red pine, pitch pine and the more important hardwoods. Although detailed measurements were not secured, enough examinations were made to give some information on the habits and relative differences of white pine, red spruce, balsam fir, and white cedar.

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[13] The importance of humus in tree growth is shown in an article on the "Influence of Certain Soil Factors on the Growth of Tree Seedlings and Wheat," in Ecology, Vol. 4, No. 1. 1922.

All four of these species germinate and root in the surface humus. Contact with the mineral soil is not necessary, though it may be advantageous, particularly for white pine.

White pine seedlings have a tendency to form a single main root which they frequently succeed in pushing down into the mineral soil. Quite as often, however, perhaps more often in the thicker humus, white pine seedlings do not penetrate the mineral soil. The main root turns and remains entirely in the humus or runs laterally between it and the mineral soil. Thus Frothingham's [14] statement that "Young plants which spring up on insufficiently decomposed leaf litter, are almost sure to die," does not hold for the conditions such as we find on Mt. Desert Island, which are probably typical of large areas of white pine in eastern New England.

Balsam fir seedlings develop strong and only slightly branched laterals in the surface humus. Frequently they send down a heavy central root which looks like the beginning of a tap-root, but which splits at the bottom of the humus into a number of laterals which remain in the organic layer. One rather small and comparatively insignificant root may continue into the mineral soil.

Red spruce seedlings seem to depend entirely on the humus; none out of a considerable number examined were found reaching down into the mineral soil. Hence the thick duff has not the disadvantage implied by Murphy's statement that it causes difficulty in the young seedlings reaching the mineral soil.[15] They do not send out strong laterals like the fir but have a system of numerous and very finely branched rootlets. They could not, therefore, survive on humus which dries out below the wilting coefficient. When, however, the duff dries except for tiny pockets of moisture, which probably often happens, they can maintain life.

White cedar seedlings root chiefly in the humus. They start with a fairly definite main root which turns horizontally and sends out side branches into the organic layer. Sometimes, however, the main root, after running horizontally, turns downward again and penetrates the mineral soil, reaching portions of it where there is no vegetable matter. Cedar appears to come next to white pine in penetration, though fir may sometimes surpass it. Among the four species considered the

[14] Frothingham, E. H. "White Pine Under Forest Management." U. S. Dept. Agri. Bull. 13. 1914.

[15] Loc. cit., footnote 3, p. 16.

order of depth of seedling penetration would be white pine, cedar, fir, and red spruce.

Sugar maple shows a distinct tendency to form a main root, which goes partly horizontally and partly downward. This penetrates the mineral soil, even where there is no humus mixed in, and sometimes reaches considerable depths. It also sends out many side branches into the humus.

Mature Form

The white pine seems to have substantial anchorage roots when it can find anything on which to an anchor. It is not confined to areas with a covering of soil, but grows on the nearly bare ledges. One of the finest stands, composed of trees 2 feet in diameter and more, is on a jumble of large boulders, almost a rock talus, partially covered with a mat of humus.

The white pine roots here seem to have a system of getting water and nutrients which is quite different from the other trees. It sends out along the side of the rootlet small clumps or clusters of white translucent absorbing cells. The clusters are often much branched, but do not seem to develop into branch rootlets. They drop off readily when the root is disturbed. Sometimes they form in many-celled masses like a miniature honeycomb, one such being found 6 mm. in width. These little absorbing clusters seem to be an efficient response to moisture and nutrients along the course traversed by the root. They resemble the feather roots (fäder wurzeln) referred to by Haasis [16] in his work on western yellow pine. White pine has also the usual form of absorbing root tip. The bulk of the feeding roots is in the humus, but some grow between the mineral soil and humus, and others in the mineral soil, showing a considerably larger proportion in the mineral soil than with spruce, fir, or white cedar.

Spruce has, of course, large roots in the mineral soil which serve for anchorage. But most of these roots spread laterally, and eventually turn up or send branches up into the surface humus. The most characteristic feature of the spruce root systems is the exceedingly fine and complete fibrous network which it forms in the duff of the forest floor. Nothing seems to escape except the newly fallen needles, and they not for long. The white absorbing tip is extremely small, only about half

[16] Haasis, F. W. "Relations Between Soil Type and Root Form in Western Yellow Pine Seedlings." Ecology, Vol. 11, No. 4. 1921.

a millimeter in length, and appears to be distinct from the darker portion further back. Unlike the clusters on the side of white pine roots, these tips become part of the bark-covered root as the rootlet extends. What they lack in size they make up in numbers and completeness of distribution. Thus, while the white pine is taking in larger quantities from certain little spots, the spruce is drawing in its nourishment from practically the entire humus blanket. Sometimes, however, spruce may have long absorbing tips merging gradually with the bark-covered part. One such case was noted in a rich neutral humus in which the translucent root tip was 16 mm. long and much thicker than the rootlet on which it was growing. Perhaps this was in response to the large amount of available nutrients and absence of acid. It was in the middle of October, and may have represented a second growing period following the autumn rains.

The quantity of water absorbed by the fine but all pervading mat of spruce roots must in the aggregate be very large, and is undoubtedly important in competition. This root habit, together with ability to endure shade, are probably the tree's main reliance in keeping alive so long under other trees. The difference between spruce and white pine roots are such that the two can grow in the same stratum without seriously interfering with each other. Possibly the mat of spruce roots may to a certain extent take away from the supply of those pine roots between the humus and mineral soil.

Balsam fir, while sending down anchorage roots, depends upon the humus for nourishment as do the other trees. Its feeding roots are much less branched than those of spruce, and much thicker. They are also somewhat greater in diameter than those of white pine. If the total length of all roots on individual trees of spruce and fir were compared the spruce would greatly exceed those of fir. The fir makes up by the greater diameter and length of its absorbing tips. The advantage is, however, with the spruce on account of better distribution. The loss of a few growing tips by dryness or fungus is a much more serious matter to the fir than to the spruce. These differences in roots may account in part for observed differences in reproduction and eventual dominance in the main stand noted below under Reproduction.

The root system of white cedar seems to be more adaptable than that of its associates. It becomes either superficial or penetrating according to the site on which it happens to be growing. In swampy places it spreads laterally, up to five meters or more, building a platform of much

branched roots over the standing water. It does not seem to be able to grow in water, and the bottom of the root systems, even in a swamp underlaid with porous gravel, looks as if it had been flattened by growing on a smooth ledge. The depth of this root layer runs from about 20 to 40 centimeters.

On rocky places cedar seems to have greater ability in pushing into the crevices and under boulders than any of its associates. It prefers crevices containing vegetable matter, but seems to go into all kinds. It grows abundantly on ordinary sites, with spruce, fir, and pine, but is frequently found clinging to the sides of vertical cliffs. Once a thick root was found which had grown for over a meter straight down into a narrow crack in the granite, and had afterwards been exposed when the cliff was cut away by the sea.

Cedar rootlets are conspicuous for their red color, are tough, and terminate in translucent root tips of considerable length, up to 10 mm. These tips are not enlarged, as with the other species, nor are they sharply set off, but merge gradually with the bark-covered part of the rootlet. The roots are much coarser than those of spruce but not more so than fir. Branching is much greater than in fir, but less than spruce. The roots fill a particular piece of humus pretty completely, but can easily be withdrawn because they are more or less straight, while those of spruce stick fast because they are interlaced. The cedar roots do not exclude those of the other species, which seem able to grow in the same spot and take what the cedar leaves.

Cedar characteristically sends out roots from the main trunk above the usual root system, beginning in the large seedling stage. This is, undoubtedly, a response to the swamp habitat, and to the constantly increasing depth of humus and moss around the base of the tree. It is an indication both of need for organic material and for oxygen. Spruce, fir, and pine do not have this power so strongly developed.

In non-acid swamps cedar seems to be the pioneer tree, at least among the conifers. The platform of roots and humus which it builds serves for the white pine, spruce, and fir. The spruce here develops its mat of fine rootlets and forms its characteristic acid humus, driving out the cedar roots.

On ordinary sites cedar is usually confined to humus not exceeding a specific acidity of 100. Here it roots in the humus, and also seeks out cracks in the rocks and between the boulders. The distribution of its roots is such as not to seriously interfere with those of its associates,

and to enable the tree to reach moisture and nutrients which are inaccessible to the others. Probably its root habit, and the rocky character of most of this island, account for its abundance here. It does not, however, reach the size which it attains on limestone soils.[17]

Beech is important in the northeast owing to its prevalence over large areas in the mixed, hardwood, and spruce forests. The beech root system resembles that of spruce in the formation of a well-distributed network of branches. The rootlets, though small, are not quite so fine as those of the spruce and not quite so all pervading. On the true hardwood type and on gravelly soils the beech tends to send down feeding roots into the mineral soil as well as to spread strongly in the humus layer. In gravel, the rootlets form well marked pockets or veins, possibly corresponding with streaks of organic matter.

Beech roots often come into direct competition with those of spruce, and the space between individuals of the two species will be densely filled with roots of both. The spruce sends its feeding roots to the base of the beech. The beech also, contrary to expectations, sends its feeding roots to the very foot of the spruce, into the needle duff having an acidity of 300+. Thus beech, though doing better in mild humus, can stand a high degree of acidity. The tree appears to prolong its root growth into the autumn longer than spruce; in one case investigated in October, the beech had many growing tips still absorbing while the spruce in the same humus mass had considerably less. The indications point to intense competition between these two trees. The ability of the beech to endure high acidity, the efficient distribution of its roots, its powers of reproducing prolifically from root suckers, and its endurance of shade are all in its favor. Whether or not it can eventually crowd out the spruce is a question. The probabilities are that it could not where enough spruce seed trees are left to provide seedlings in the under-story.

Whether or not the beech here increases soil fertility, as it is said to do in Europe, is unknown. It may or may not be significant that earthworms—a fair indication of fertility—were found among the roots of beech in a gravelly soil.

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[17] Fernald, M. L. "Lithological Factors Limiting the Ranges of *Pinus Banksiana* and *Thuja occidentalis*." Rhodora, Vol. 21, No. 243, pp. 41-67. 1919. Rev. JOURNAL OF FORESTRY, Vol. 17, pp. 884-889. 1919. Bot. Abs., Vol. 4, entry 283. 1920.

Sugar maple is also an important competitor in the spruce and northern hardwoods type. Like its associates, it depends largely on the humus. Its roots have numerous branches, but seem to be less ramified and interlaced than those of beech. Sometimes the tip of the growing root is provided with a pointed cap resembling a bud-scale, which pushes through the humus. The sugar maple's absorbing ends are conspicuously different from those of its associates. They are not mere tips as with the beech and others, but long white translucent filaments as much as 6 centimeters in length growing out of the side of the rootlet. Each filament is covered with a sheath which pulls off very easily, leaving a fine white thread. Although growing in vegetable matter filled with white and yellow fungi, which may have been mycorhizal on other species, the maple roots were singularly free from mycelium. They were cleaner than those of any of the other species examined, with the possible exception of cedar. Although the maple roots do not appear to be as thoroughly distributed as those of beech, the water absorption per unit of root length must be much larger. It is possible that the difference in distribution allows beech and maple roots to grow in the same stratum with comparatively little interference; but, where abundant, maple roots must take up enormous quantities of water.

Yellow birch is the other important component of the spruce and northern hardwood (beech-birch-maple-spruce) type. This tree sends out many roots for very long distances from the trunk. It is possible that the greater conspicuousness of these roots, coming to the surface far from the parent tree, may give an exaggerated impression of their length as compared with that of other trees. The feeding roots are very fine and fibrous, more so than either beech or sugar maple, and are frequently covered with a yellow mycelium resembling the Cortinarius mycorhiza found on spruce and fir.

Mycorhizas

All the conifers except white cedar have mycorhizal fungi on their roots in greater or less profusion. The spruce and fir in particular have an abundance of two kinds which form respectively white and yellow mycelium; the white kind is also common white pine. The fruiting bodies of these two were found attached to the mycelium; they were both small brown mushrooms and were kindly identified by Dr. W. B. McDougall as species of Cortinarius. He states that these are the first authentic records of identification of mycorhizal fungi on

Picea and Abies. They are both ectotrophic, on the outside of the rootlets. A reddish colored mycelium was also found on spruce, but was not common.

White pine seedlings growing in openings in a stand composed chiefly of spruce were found to have on the ends of certain of their roots small buff-colored nodules 1.5 to 4 mm. wide by 1.5 mm. thick. Dr. W. B. McDougall has cut and examined microscopic sections of these, and states that they are "coral" mycorhizal clusters with the parts bound together by mycelium. These nodules appear to be infrequent on Mt. Desert Island.

Of the hardwoods, yellow birch had abundant yellow mycelium on its roots, which appeared to be the same yellow mycorhizal fungus as found on the conifers.

Beech roots in some localities on this island have the beech-drop, *Epiphegus virginiana.* This plant here grows for some distance, occasionally 10 centimeters or more, between the leaves before it succeeds in forcing its way up through; above ground it is not more than 10 centimeters high, generally less. The attachment in each case examined was found to be on only a single tiny root-tip, which appeared dead. The roots back of the point of attachment were not enlarged as stated by Rankin,[18] and probably suffered very little if any damage from this parasite. The stiff outgrowths, or "grapplers" on the rhizomes of the beech-drop were 2 to 5 mm. long, and must, it seems, act as roots in contributing moisture and nutrients, because the small rootlet of the beech hardly seems sufficient. Furthermore, attachment was directly on the rhizome, not on one of the "grapplers."

The roots of all trees, white cedar and sugar maple to a very limited extent, have a fine black bristly or filamentous growth unlike the mycorhizas above mentioned. This looks something like the black snow-fungus sometimes found on branches after the snow has melted. It is generally on dead rootlets, but has been seen on functioning root tips of spruce and fir; often there is the white mycelium on the same root tip. Although the black threads are wound around the rootlets, they seem to send out hairs from the inside.

The exact relation of the mycorhizal fungi to the tree roots and to the duff is not known. If they are parasites on the roots, they do not

[18] Rankin, W. Howard. "Manual of Tree Diseases." P. 108. Macmillan Co., N. Y. 1918.

seem to do much harm. It may be that they are entirely saprophytic, attaching themselves to the rootlets to insure distribution, and securing their nourishment from the humus and from the dead rootlets. Cases of both white and yellow mychorizas were found in which the mycelium was on the rootlets of spruce and not on the surrounding particles of duff. In general white mycelium is pretty thoroughly distributed through the humus, though it may not all belong to the mycorhizal Cortinarius; the yellow mycelium appears to be more or less confined to the rootlets. It seems probable that the mycorhizal fungi help to disintegrate the needles and litter. It is also possible that they absorb nitrogen and other elements from the duff in combinations not readily usable by the tree roots, and convert them into nutrient forms which are then utilized by the root. They seem to eventually choke the root tip with their covering, but perhaps not until after the rootlet has fulfilled its function. New tips are constantly being formed, so this would not seriously hamper the tree. The black fungus appears to be less useful, though this may not be the case.

It is well known that fungi play the leading part in breaking down forest humus and making it available to plants, just as bacteria do in cultivated soils. In any case the duff is universally filled with various fungi. Certain bacteria can withstand the high acidity, but probably they play a comparatively minor part. Insects help disintegration to a certain extent by disseminating fungus spores and by breaking down the plant remains.

REPRODUCTION

Conifers

Reproduction of white pine, spruce, and fir are abundant almost everywhere on the coniferous humus, except on the grey duff under dense crowns, where it is prevented by lack of moisture as already described.[19] Cedar reproduction is also abundant, but is somewhat more local than that of the three foregoing species. Germination occurs directly in the humus, contact with the mineral soil seeming unnecessary. Abandoned fields, and even pastures still in use, are rapidly seeded with spruce and white pine.

[19] The extent to which moisture can counterbalance lack of light has been demonstrated by Burns, who found that an abundant water supply counteracted the shade produced by six thicknesses of cheesecloth. Unpublished experiment referred to in "Plants and Animals of Mt. Marcy, N. Y." Ecology, Vol. I, No. 3, p. 205. 1920.

White pine is extremely prolific, coming up in large numbers under the forest and on the rock ledges which have only a very thin layer of vegetable matter under a growth of lichens, potentilla and blueberry. It thus not only maintains itself in the stand but occupies new areas too dry for spruce, fir, or cedar, and apparently too cold for pitch pine. On certain of these ledges red pine grows with it, but more often it is the only coniferous tree.

The high degree of drought resistance possessed by white pine confirms the statement of Hawley and Hawes [20] that this tree "is very indifferent in its demands upon soil and moisture," and was strikingly illustrated during the extremely dry summer of 1921. During June the mean temperature (at Eastport, the nearest Weather Bureau Station) was 1.2 F. above normal, while the precipitation was less than one-third of what it should have been, only 1.02 inches instead of 3.22. During July the precipitation was approximately half of normal, 1.79 instead of 3.39 inches. In many places the potentilla, itself rather drought resistant, the blueberry, birch seedlings, and other plants wilted and turned brown. The white pine suffered a number of fatalities, in one case 50 per cent, in another 13 per cent of the seedlings over two years old. Even older seedlings were affected, though in many cases these recovered. On the whole, however, the casualties of white pine over two years old were surprisingly small, probably not exceeding 10 per cent in the open situations, and 5 per cent altogether, if that much.

Red spruce reproduces abundantly in the larger openings, though not on the drier ledges with the pine, and is very plentiful in small openings and under the crowns in the forest. It even succeeds in establishing itself not infrequently on the grey duff where nothing else can grow. A possible reason for its success is that it grows very slowly at first, attaining a height of only about 5 to 10 centimeters in 7 or 8 years, thus having a very small transpiring surface and low water requirement. Both spruces, red and white, appear to be not only holding their own on this island, but increasing. They will not, however, be able to crowd out the white pine because it reproduces so prolifically and grows so much more rapidly.

In the hardwood and spruce type, where the leaf layer is not matted down, there is an abundance of spruce reproduction in the vicinity of those spruce trees which are in or above the main crown canopy.

[20] Loc. cit., footnote 2, p. 39.

This reproduction is, however, beneath the hardwood cover and must wait for openings before it can grow to any size. Where the leaf layer is matted and thick, spruce reproduction is scattering. The hardwood leaves are here unfavorable, not only in hindering the penetration of spruce roots, but in preventing the tops from coming to the surface. From the behavior of other plants in this type of litter it seems probable that the spruce seedlings germinate, grow between the leaves for a certain distance, but are unable to prick up through. On the whole, spruce can be perpetuated in the hardwood type if suitable seed trees are left, and openings made in the hardwood canopy near these seed trees. The latter provision depends, of course, on the possibility of utilizing hardwoods, which in turn depends largely on transportation. When there has been devised some method of making these woods float, such as girdling before felling, or felling in summer and leaving the tops on, the problem will be solved. This should involve no insuperable obstacle. Where there is still spruce in the stand, it is more than likely that it can be estimated by methods which will cost less than planting.

The distance of red spruce seed dissemination, and period of restocking, were illustrated on area which had been clear cut and burned alongside of an untouched body of mature timber of the spruce flat type. The unburned stand was about 22 to 25 meters high and composed of red spruce with an admixture of hemlock, white cedar, and a little white pine. It lay to the west of the burn, forming a fairly sharp north and south line and giving the benefit of the prevailing westerly winds for seed distribution. The cutting, determined by a number of increment borer counts of increased growth on remaining trees, was 18 years ago, in 1903. The fire, from counts of hardwood sprouts and scars on spruce at the edge of the burn, was 17 years ago, in 1904. Apparently most of the duff had been destroyed by the fire, leaving coniferous reproduction dependent on seed from the adjacent uncut timber. The reproduction covered a remarkably definite strip bordering the uncut forest. Up to approximately 30 meters (1½ chains) there was a heavy growth of seedlings; up to 60 meters (3 chains) there was approximately full stocking. Beyond this there were only scattered seedlings, which diminished in numbers as the distance from the seed trees increased. A safe distance then, even with a heavy stand of seed trees, favorable wind, and level topography would be about 60 meters, or not over 200 feet, about 2½ times the height of the seed trees, or less.

The oldest spruce seedlings were 14 years old, indicating a period of three years for reproduction to start. Trees of this age, were, however, only scattering. Those of 11 years were fairly abundant, enough to make a reasonably full stand up to about 40 meters (approximately 2 chains) from the uncut timber. In this case, which is probably fairly typical, it took six years after the fire for the strip to restock with spruce. Younger ages are represented, showing that seedlings continue to establish themselves, probably until the canopy becomes too dense. Cedar reproduction was common, but younger than a considerable portion of the spruce, indicating a period of about 8 years for establishment. Hemlock seedlings were also younger than the spruce, were few in numbers, and occurred in locally favored spots. White pine, though represented in the main stand, produced only two seedlings, 14 and 13 years old; the area was not a white pine site. Fir reproduction was scarce except immediately next to the uncut timber; the oldest was 15 years.

There was a certain admixture of hardwoods before the stand was cut and burned. Of these, white birch has sent up a certain number of sprouts. Beech roots were here and there left with sufficient life to put forth root suckers, some of the suckers coming from roots which show considerable injury.

For the northeast as a whole, and Mt. Desert Island in particular, the reproduction of balsam fir is difficult to explain. It frequently comes up in dense, nearly pure thickets under the birches which have followed a fire, and it completely covers the ground under pure stands of white pine. Yet there are frequently no seed trees in sight. It has been found to reproduce by layering, a branch becoming buried, developing roots and sending up a new tree. This undoubtedly accounts for some young growth, but for how much?

In spite of its strong powers of reproduction, fir here plays a minor part in the main stand. Most of it dies before it reaches pole size, and those trees which succeed in coming up into the canopy do not last long. Its high susceptibility to rot is well known. Possibly also the character of the roots may be of importance. Rootlets destroyed by fungi may not be so readily replaced as with spruce and pine. It must also be remembered that the center of distribution of fir is north of that of its competitors and that it is, therefore, at somewhat of a dis-

advantage. Just below the timber line in the northeast it forms pure stands.[21]

White cedar reproduces abundantly in pockets. Moisture seems to be the leading factor; low acidity is also important for success. The humus in which it starts has, for the most part, a specific acidity of 100, which is rather high for this tree and prevents its attaining its best development. While the majority of reproduction is from seed, young trees which have started from buried branches by layering are common.

Young coniferous seedlings in the forest, as well as in the nursery, must be subject to damping off. That one or more organisms causing this disease is abundant in the coniferous humus was determined experimentally. It is significant that the losses from damping off were much greater on dry than on moist humus.[22] This result was obtained with red pine, but undoubtedly holds for other species. It is probably due in part to the lower vigor and slower growth of seedlings having insufficient moisture, and possibly also, to there being less acid in solution to kill the organism causing the disease, which is known to be sensitive to acid.

Hardwoods

Among the hardwoods in the hardwood-spruce type, beech here reproduces abundantly from root suckers, and probably also a certain amount from seed, though seedlings are uncommon. This species extends beyond the true beech-birch-spruce-maple type and forms groups of numerous individuals in some of the stands of mixed white pine, spruce, and red oak.

Yellow birch reproduction does not seem to be plentiful on Mt. Desert Island, though the tree is prominent here in the hardwood and spruce type. Outside of this type it is found scatteringly on the moister protected situations.

Sugar maple seedlings are abundant under the canopy of the main stand, but are largely confined to the beech-birch-maple-spruce combination. Elsewhere they are rare, and the tree is found only as an occasional individual on sheltered, moist sites.

Red oak is abundant and reproduces in large numbers over most of the island except in the spruce type, and in the hardwoods and spruce.

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[21] "Plants and Animals of Mt. Marcy, New York." Ecology, Vol. 1, Nos. 2, 3, and 4. 1920.

[22] Loc. cit., footnote 1, p. 850.

It produces heavy crops of acorns, apparently at frequent intervals, and its seedlings send down long thick tap-roots the first year. It seems to survive well under a moderate canopy and develops into a fair-sized tree where it finds sufficient depth of soil.

Periodicity in Reproduction

The years in which reproduction becomes established, or periodicity of reproduction, was studied by tallying seedlings according to age determined by the nodes between each year's growth, checked by ring counts. The method is not always sure, because there is sometimes uncertainty as to the exact age, especially with cedar. Even with the greatest precautions, and omitting certain seedlings, there are bound to be errors. However, the method has distinct uses where young seedlings of different species are abundant, as in this case, and also probably in the mixed sugar pine, yellow pine, Douglas fir, incense cedar forests of the Sierras.

The results are here given rather for their suggestive than for their positive value. A total of 126 seedlings were recorded by age on an area of approximately 3 by 4 meters; 72 red spruce, 27 white cedar, 18 white pine, and 9 balsam fir. The red spruce had come in most abundantly in the years 1913 to 1916 inclusive, with some scattering up to 1919, but none in 1920 or 1921. The cedar had started in 1918 to 1920 inclusive, a few in 1916 and 1917, but none in 1921 or 1913 to 1915. The white pine had come in 1919 and 1920, very few in some of the other years. Most of the fir had germinated before 1913, with one each for 1913 to 1916 inclusive, and one in 1921.

Further studies of this kind would show whether or not the years of most abundant reproduction differ with each species, and would give a certain amount of information which would be helpful in determining the relative bearing of seed abundance, and of conditions at the time of germination, upon quantity of reproduction.

SUMMARY

The principal commercial forest types of the northeast are well represented on Mt. Desert Island, Maine. Bold relief, glaciation, and submergence beneath the sea have created a wide variety of sites; the predominant ones are granite rock and boulder till, with patches of gravel and of clay. The mineral soil in its natural condition is infertile. A blanket of poorly disintegrated humus or duff covers rock and

soil. This is sharply differentiated from the underlying stratum, and causes the formation in most places of an underlying ashy grey layer of leached soil or rock particles. Most of the humus is poorly disintegrated and acid; the reasons are considered, and specific acidities (Wherry method) given. This humus is the main reliance of the forests for growth and, except on the hardwood type, contains at least 90 per cent of the feeding roots of all trees. There are strong indications that the absence of vegetation under dense canopies is due to lack of moisture rather than to shade.

The seedling root systems show differences which have an important bearing on the establishment of reproduction. The mature root form of each species has characteristics which influence its success or failure in competition with other species. Mycorhizal fungi of Cortinarius were found on spruce, fir, and white pine.

The young growth of white pine, spruce, balsam fir, white cedar, beech, yellow birch, and sugar maple, gives certain indications of the factors influencing the natural restocking of each of these species. Spruce reproduction on a certain cut and burned area showed the distance to which spruce seed is disseminated, and the period required for full stocking, under certain conditions. In mixed stands, the years in which the different species become established can be studied by a simple method and used in comparative studies of reproduction of different species.

MYCORHIZAS OF CONIFEROUS TREES

By W. B. McDougall,
University of Illinois.

Although it has been known for a long time that most of the common gymnospermous trees usually possess ectotrophic mycorhizas, very little careful work has been done on them so that our knowledge of them is very meager both as to their morphological characteristics and as to the fungi that cause them to be produced. Stahl (*7*) stated that the fir has ectotrophic and the yew endotrophic mycorhizas and that the juniper may have both forms. He did not give any structural details and he had no knowledge of the causal organisms. Moller (*4*) found that the spruce seedlings with which he worked usually possessed ectotrophic mycorhizas but occasionally also produced endotrophic forms. McDougall (*3*) reported ectotrophic mycorhizas on Larix laricina and figured a cross section of one of them. The mycorhizal fungus was not determined. Extremely few authentic reports of ectotrophic mycorhizal fungi on coniferous trees have been made. Rees (*6*) reported Elaphomyces granulatus on pine and Noack (*5*) reported Geaster fimbriatus, G. fornicatus and Cortinarious callisteus on pine and Tricholoma terreus on spruce.

I am indebted to Dr. Barrington Moore for the materials on which the present paper is based. They were collected by Dr. Moore at Bar Harbor, Mount Desert Island, Maine, October 19, 1921, and reached me a few days later. Studies of the fresh materials were made at once and then portions of each collection were embedded for sectioning and more detailed study later. The collections included mycorhizas from Picea rubra, Abies balsamea, and Pinus strobus together with fruit bodies of the mycorhizal fungi of the Picea rubra and Abies balsamea mycorhizas. The collections from the three species of trees will be described separately.

PICEA RUBRA

The mycorhizal fungus: Cortinarius sp. Cap 2½ cm. broad, brick-red to reddish brown, with a distinct viscid pellicle Gills dark cinnamon color, moderately close, 4-5 mm. broad. Stem equal except for a slight bulbous enlargement at the base, 4½ cm. long. Veil distinctly

cobwebby, not forming an annulus. Spores 8-16x7-8 microns. Flesh pale yellowish. Taste mild. Mycelium bright yellowish and very sparse except in connection with the roots.

It is well known to all mycologists that it is usually impossible to determine species of Cortinarius when only a single developmental stage is available, especially if the specimens are not perfectly fresh. The above description will enable anyone to know what sort of fruit body is produced by this mycorhizal fungus and in case of future collections on Picea to determine whether there is a probability that these represent the same species or not. Dr. Moore reports that the same fungus forms mycorhizas on balsam fir, yellow birch and possibly others.

It is probable that a considerable number of species of Cortinarius are mycorhiza forming fungi since several have already been reported. Besides the one reported by Noack (5) on Pinus, mentioned above,

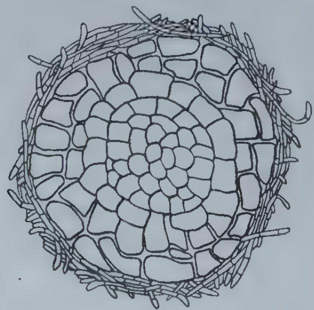

Fig. 1.—Cross section of ectotrophic mycorhiza of Picea rubra.

the same author reported C. caerulescens on Fagus and C. fulmineus on Quercus, Kauffman (1) reported C. rubipes on Quercus rubra, Acer saccharum, and Celastrus scandens, and McDougall (3) reported Cortinarius sp. on Betula alba var. papyrifera. The present report, however, is believed to be the first authentic record of identification of a mycorhizal fungus on Picea.

The mycorhizas: The mycorhizas of Picea rubra are bright yellow due to the color of the mycelium. They are very small and do not form typical coral clusters as a rule, only one or two branches in a place being common. The fungus mantle appears under a lens to be rather loose and this impression is confirmed by a study of a microsopic section. Figure 1 shows such a section. The fungus layer is there seen to be rather thin and not very compact. The fungus has

penetrated between the first and often also the second row of cortical root cells but these cells do not become radically elongated as do those of the mycorhizas of many hardwood trees.

ABIES BALSAMEA

The mycorhizal fungus: Cortinarius sp. Cap 1 cm. broad, tan color, without glutinous pellicle. Gills cinnamon color, not close, 2½ mm. broad. Stem white, equal, 3½ cm. long, 4 mm. thick. No annulus. Veil not evident. Spores 6-8x3-4 microns. Flesh very thin, white, taste mild. Mycelium white and very abundant in the humus. The same fungus is believed by Dr. Moore to produce mycorhizas on spruce and white pine.

Fig. 2.—Root system of white pine seedling with tubercle-like compound mycorhizas.

The mycorhizas: The mycorhizas of Abies balsamea are very similar to those of Picea rubra except in color which in the Abies mycorhiza is white, due to the white color of the mycelium of the mycorhizal fungus. The structural features of the mycorhizas of the two species are so similar that it is not deemed necessary to present illustrations

of both. A drawing of a cross section of a mycorhiza from Abies would look very similar to the one from Picea that is presented in figure 1.

The relatively thin and loosely constructed fungus mantle may be somewhat characteristic of mycorhizas caused by species of Cortinarius since the mycorhizas of Betula papyrifera which are caused by a Cortinarius also have a similar mantle. This is not invariable, however, since the mantle on the mycorhizas of Acer saccharum, reported by Kauffman (*1*) as due to Cortinarius rubipes was of quite a different character. Kauffman did not give an illustration but a microscopic slide showing a section of one of these mycorhizas which he kindly allowed the present writer to examine showed a mantle similar to that described by McDougall (*3*) as "form 1" on Carya alba and illustrated in section by his figure 2.

PINUS STROBUS

The collection of Pinus strobus material consisted of two seedlings with several peculiar nodules on their roots that to the naked eye looked very much like the tubercles on the roots of leguminous plants. (Figure 2.) The nodules were pale yellowish or buff colored and varied from one to four millimeters in diameter. They are obviously not common since Dr. Moore wrote that he had examined considerable numbers of Pinus strobus roots and these were the only ones he had seen with nodules on them.

Figure 3 shows a section of one of these "nodules" and demonstrates at once what its true character is. It is in a sense a compound mycorhiza or more strictly speaking it is a "coral" cluster of mycorhiza with the parts all bound together in one mass by the enveloping mycelium. One of the largest nodules from which some free hand sections were cut contained ten root branches while the one illustrated in figure 3 contained eight.

So far as I am aware no structures at all similar to these have ever before been described. "Coral" clusters of mycorhizas containing large numbers of rootlets are well known. Möller (*4*) reported a cluster on a spruce seedling that, judging from his illustrations, must have contained altogether a total of a hundred or more rootlets and I have frequently seen comparable if somewhat smaller clusters on the roots of oak and hickory species. The case that we are reporting here, however, in which the rootlets are bound together by the mycelium into a

compact tubercle seems to be entirely unique. The character of the fungus tissue, as well as of the surface of the tubercle, is very similar to what is found in many other ectotrophic mycorhizas. The formation of the tubercles, therefore, may have been due merely to a much more luxuriant growth of the mycelium than ordinarily takes place in the formation of mycorhiza and this luxuriance may be character-

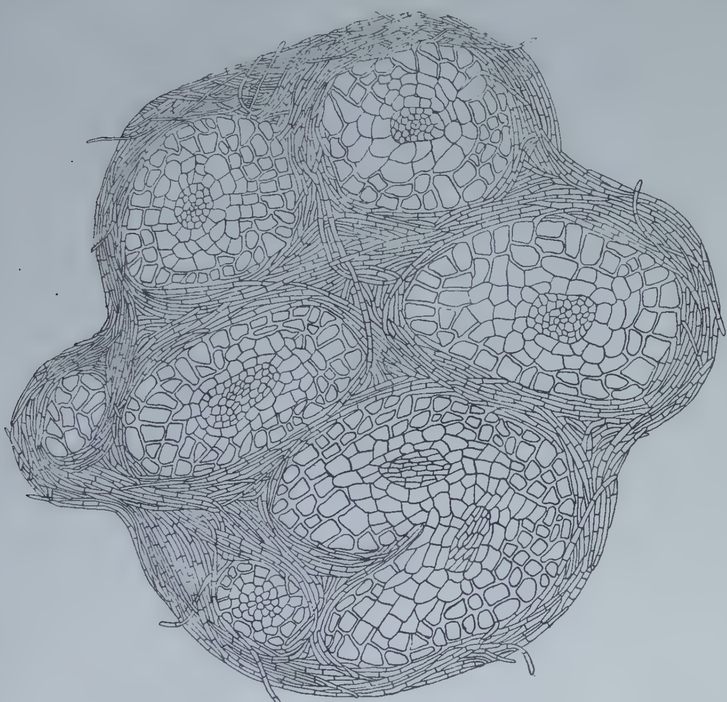

Fig. 3.—Cross section of tubercle-like compound mycorhiza of Pinus strobus.

istic of the species of fungus concerned or it may have been due to unusually favorable vegetative conditions at the time. No sporophores were found in connection with these tubercles and, therefore, the identity of the causal fungus remains unknown.

CONCLUSION

The main contributions contained in the present paper may be summaried as follows:

1. Two generic determinations are added to the known list of ectotrophic mycorhiza forming fungi: a Cortinarius with yellow mycelium

on red spruce, balsam fir and yellow birch and a Cortinarius with white mycelium on red spruce, balsam fir and white pine.

2. The structural characteristics of the yellow mycorhizas of red spruce and the white mycorhizas of balsam fir are given and the former is figured in cross section.

3. A unique tubercle-like compound mycorhiza of white pine seedlings is described and figured in cross section.

It was formerly believed that the ectotrophic mycorhizal fungi were of considerable benefit to the host plants in that they aided them in absorbing materials from the soil and this old idea is still retained in many, even of the latest, botanical text-books. There is no evidence in favor of such a hypothesis, however, and it is the consensus of opinion among recent workers on these structures that the fungi are merely parasitic on the roots of the higher plants and that the higher plants receive no benefit at all from the association. In other words ectotrophic mycorhizas are representative cases of antagonistic nutritive conjunctive symbiosis (*2*). It is probable that as a rule no great harm to the higher plant results from this parasitism of its roots by mycorhizal fungi. If the mycorhizas become unusually abundant, however, especially in the case of tree seedlings, they may interfere with the functioning of the root system to such an extent as to become serious, just as insect galls when they become unusually thick on leaves may interfere with the proper functioning of the leaves to such an extent as to seriously menace the health of the host plant.

The fungus tissue of an ectoprophic mycorhiza reminds one very much of the tissue of a sclerotium. A sclerotium is a structure in which food is stored in preparation for the production of fruit. Now it is believed that mycorhizal fungi produce their fruit bodies soon after they have fully established mycorhizal relations with a host plant. It seems probable, therefore, that, in a sense, the mycorhiza takes the place of a sclerotium, and it may be that the tubercle-like bodies described in this paper are due to a greater tendency to sclerotia formation in the fungus concerned than is true of most mycorhizal fungi.

LITERATURE CITED.

1.—Kauffman, C. H. Cortinarius as a mycorhiza-producing fungus. Bot. Gaz., 42:208. 1906.

2.—McDougall, W. B. The classification of symbiotic phenomena. Plant World, 21:250. 1918.

3.— ———. On the mycorhizas of forest trees. Am. Jour. Bot., 1:51. 1914.

4.—Möller, A. Über die Wurzelbildung der ein-und zweijährigen Kiefer in Markischen Landboden. Zeit. fur. Forst-und Jagdwesen, 35:257. 1903.

5.—Noack, R. Ueber Mycorhizenbildende Pilze. Bot. Zeit., 47:389. 1889.

6.—Rees, M. Ueber den Parasitismus von Elaphomyces granulatus. Bot. Zeit., 38:729. 1880.

7.—Stahl, E. Der Sinn der Mycorhizen-bildung. Jahrb. fur Wiss. Bot., 34:539. 1900.

BETTER WOODLOT MANAGEMENT[1]

By K. W. Woodward

New Hampshire State College

IMPORTANCE OF WOODLOTS

Farmers' woodlots promise to be one of the important stop gaps to tide us over the period when our accessible saw timber shall have been cut and we have to wait for young growth to reach merchantable size. Even now they contain one-sixth of the standing timber in the United States (U. S. D. A. Bulletin No. 481). With a marked decrease in the other kinds of ownership this proportion will, of course, increase. Certainly they will always remain the most important single group of private woodland holdings. However, even if their area were not significant, their accessibility alone would make them worth careful consideration in any scheme to put the United States on a sustained annual yield. Still another reason why foresters should be interested in them is that the profession of farming is now more completely reachable than any other form of business. With the complicated machinery of the Department of Agriculture having this as its main object, any kind of information can be more quickly and more persistently brought and kept before the farmer than before merchants, lawyers, doctors or other professions, provided—and here is where the rub comes—the leaders of the Department are convinced of its value to the farmer.

THE AGRICULTURAL EXPERT

That the idea of forestry has not been "sold" to the agricultural leaders the facts show for themselves. Out of fifty agricultural experiment stations less than a third consider it worth while to have a forester on their staffs. Even when they do carry his name on their stationery he is often so tied up with other duties as to be of very little value in research or extension work. Bluntly put, why should bureau chiefs, station directors, farm bureau leaders, and county agents have thousands to spend on crops which yield much less per annum while woodlot work receives but scanty consideration? First of all, it should

[1] Presented at the meeting of the Forestry Section of the American Association for the Advancement of Science, Dec. 28, 1921.

be said in partial justification that these leaders must do what their constituents demand and until the farmers themselves want to know how to manage their woodlots better there can and should be no attempt to cram the information down their throats. This is, however, but part of the story. Leaders are paid to lead. It is their job to pick not the temporarily popular move, but the line of action that will bring the best results in the long run. Why, then, do not agricultural leaders see promise in woodlot work? To answer this question their training and experience needs examination because every man carries out the theories which he consciously or unconsciously believes are sound.

Obviously, this is no place to attempt to analyze the development of agricultural education. Nowhere has it reached a higher development than in the United States. It is a complex subject with many and various phases. It does seem pertinent, however, to call attention to certain aspects which affect woodlot management. In the first place our agricultural development and education have been dominated by two assumptions: (1) Tillage is the criterion of good farming. (2) All land may be tilled if enough skill and labor are applied. As a consequence of these fundamental conceptions the ideal farm of the text books and farm councils is a level piece of land all capable of tillage. Pasturing is simply a low use only to be employed in pioneer conditions or with low value land. A piece of untilled land is a disgrace and indication of poor management. That these assumptions do not jibe with the economic facts has not yet seriously undermined them. Farm management is but twenty-five years old and its findings are only beginning to influence agricultural education. The theory and practice are still for the most part uncorrelated directions for the handling of single crops or annual products. The show farms are specialty enterprises which either strike no balance sheets or make no attempt to utilize all their land. In other words, farming is still too often in the stage that the meat packing business was before the development of the profitable by-products. Attention is concentrated on one or, perhaps, two crops. It is, therefore, perfectly natural that the woodlots should receive scant consideration. Since they occupy untillable land, they are not worthy of a real farmer's attention. It should, of course, be added that raising timber has only been economicallly advisable for the last fifty years. Only the latest text books can be expected to be cognizant of such a recent development.

THE FORESTER'S FAULTS

Furthermore, foresters are not wholly blameless. Impressed with the long time required for their crop to reach maturity, they have failed to recognize that compound interest runs against other forms of business, too. The returns for long periods and over large areas are always small. Professor Roth has brought this out very clearly in his "Forest Valuation." So, in order to speak the same language as farm experts, foresters must limit themselves to short periods. Farming is run not on what it will bring in a period of twenty-five or fifty years, but what can be made—with luck—this year. In other words, instead of stressing the fact that a plantation of white pine takes fifty years to mature, why not bring out the equally important fact that fully socked land is worth more than unplanted. While there is much understocked woodland, there are also overstocked holdings. Thinnings bring as real money as mature timber. With farm woodlots, at least, we are dealing with small areas capable of intensive management. Of course, everything advised must accord with the principles of farm management. Only the advocates of the well established and respectable farm crops can afford to ignore this most important subject.

THE REMEDIES

Improvement must, therefore, be slow. Education is always more or less painful. Competition will force the agricultural experts to ask how may a given farm be made to produce the highest yields rather than how may a given crop be grown all over said farm. Foresters must learn to talk the language of ordinary business, taking heart from the knowledge that while all long time, wide average returns are low, you and I must make high rates of interest in the next five years to offset the mistakes of less gifted foresters; or, perhaps, it would be more modest to say "our own mistakes in less fortunate moments." The inexorable logic of farm management is bringing foresters and farm experts to see their respective jobs as merely phases of the big problem of land management.

SOME PHASES OF FORESTRY EXTENSION WORK[1]

By C. R. Anderson

Pennsylvania State College

No program for the advancement of the practice of forestry in the United States can be considered complete which leaves out of account the farmer and his woodlot. This statement cannot be refuted; at the same time it perhaps needs no further proofs than those which have already appeared in print in one publication or another. Let me quote a few figures to remind us of the importance of the farm woodland. Report on Senate Resolution 311 says that the farm woodland area on the farms of the Eastern United States—those east of the Great Plains—is over 152,000,000 acres, or almost one-third of all the timbered and brush land of the whole United States, and for the country covered, over 44 per cent of all its timbered and brush land; and, what is equally significant, the same report credits the farmers of the Eastern United States with owning *40 per cent of all* of the timber of the Eastern United States. In some of the States the farmers own nearly all the remaining timber, and we judge that in all those now in the import column, they own more than 50 per cent of that remaining. In Pennsylvania, the Department of Forestry gives evidence of their collective ownership by saying "the direct damage from forest fires is the smallest of all losses from forest destruction—probably less than $500,000 a year—because outside of the farmers' woodlots there is so little valuable timber left to burn." In that State, we are certain that the farmers own not less than one-third of all the timberland, and we believe that they own not less than two-thirds of all the timber. The Conservation Commission of the State of New York in its Ninth Annual Report states that out of a total of 12,000,000 acres of timberland in that State the farmers' woodlots total 4,100,000 acres. These statistics could be continued at length, but it is not our purpose here to quote figures. Please do not infer that the farm holdings of Canada and the Western United States are unimportant; they are of considerable importance.

[1] Presented at the meeting of the Forestry Section of the American Association for the Advancement of Science, Dec. 28, 1921.

What are the possibilities of these 150-odd million acres of farm woodland, if put to work rightly? Can they contribute sufficiently to our waning lumber supply to be counted? If they cannot, then some of our States may almost as well give up at once the idea of ever doing much to help themselves when the scarcity of timber hits them rightly. If they can, and we believe this is possible, then they should be put to work, and the sooner the better.

It is impossible to forecast to what extent the acreage now found in farm woodlands will be reduced in the future through clearing for farming purposes. In some of the States the maximum would appear to have been reached; this is particularly true of the Northern and Eastern States, and probably in the Middle West. The South, on the other hand, and the Lake States, are likely to see further clearing of land now contained in farms. My guess is that the acreage of woodland in the farms of the Eastern United States will not fall much below 125,000,000 acres in the next half century.

If this land is put to work rightly it ought to do better in growth than the 150 board feet per acre thought by the United States Forest Service to be a fair estimate of the possible growth on the timbered lands of the country. The New York State College of Forestry states in its Bulletin No. 13, "Forestry for the Private Owner," that it considers that the bulk of the woodlots of the State of New York will equal 200 board feet per acre per year.

I believe we are sufficiently conservative when we assume that the average growth for the woodlots of the Eastern United States can be made to be 200 board feet per acre per year. If we set our area at 125,000,000 acres, we thus obtain the total of 25,000,000,000 of material, or well on to half as much lumber as the equivalent in lumber of all the products cut annually at present in the whole United States, using again figures from Report on Senate Resolution 311.

THE SMITH-LEVER ACT

How are we to insure that this farm woodland area will be put to work rightly? There is absolutely no questioning the truth of the statement that the problem is a large one. At that, it is only one part of a still larger problem—how shall the farmer be assisted best to handle most wisely all the parts of his problem—his agricultural land, his pasture land, his poultry, pigs, cows, and *his woodland?* For a long time the U. S. Department of Agriculture and the State Depart-

ments of Agriculture thought that the work of converting the findings of research into active farm practice could be done sufficiently well through the bulletin and the circular. But on May 8, 1914, there was passed the Smith-Lever Act, which made it possible for the county, the State, and the Federal Government, acting together, to put the county agent in the field to supplement printed matter by visual instruction in the form of demonstration. Up to the advent of the Farm Bureau with its agent, a very large percentage of all farmers believed that "a cow is a cow, and that's all there is to it." There wasn't even one single branch of farming, so far as I know, in which common practice followed *closely* on scientific knowledge available with respect to that branch. The farmer had to be shown. He has now been shown and is following the new lead—slowly in many cases, to be sure—organizing his farm so that greater success may attend the effort expended. It is no exaggeration to say that scientific farming in this country has made greater progress on the farm in the last seven years than it had made in all of the years prior to that time during which the U. S. Department of Agriculture was functioning.

The farm woodlot is a part of the farm. It is as much a part of the average farm as the poultry plant or the garden. The fact that it has been neglected in the past proves nothing; so was the average poultry flock neglected. The farm woodlot simply means one more line on which the farmer must be shown if he is to have it contribute more to his farm's success and his country's needs.

Under the Smith-Lever Act a beginning only has been made in farm forestry extension. Under date of November 29, 1921, W. R. Mattoon, who had charge of extension work in farm forestry for the United States Forestry Service and the States Relations Service, writes as follows concerning the organization to date:

"According to the records of the Office of Extension, States Relations Service, the situation is about as follows: Pennsylvania and New York appear to be the only States regularly employing extension specialists. The specialist in North Carolina recently resigned and is now with the Timber Section of the Internal Revenue Bureau in Washington. Formal cooperative relations are in force between the extension divisions of the agricultural colleges and the State forestry organizations in Maryland, Virginia, and Tennessee. . . .

"In a number of other States informal cooperation exists between the two organizations, as shown by concrete results in 1920 in California, Colorado, Minnesota, and Michigan. It appears that up to about

a year ago Michigan devoted Smith-Lever funds to farm forestry and was obliged to discontinue the work. In addition, the records show that county agents carried on forestry work . . . in Nebraska and Montana . . . and in South Carolina, Mississippi, and Louisiana."

The New York State School of Forestry at Syracuse employs an extension force. It has no relation, however, to the work done under the Smith-Lever Act, which is centered at Cornell University.

I would not for a moment ask you to believe that a force of two men in New York, and one in Pennsylvania, and the arrangements cited for each of the several other States mentioned, is adequate to direct farm woodland extension work in these States. It sounds farcical, for example, to imagine that a single individual can do the work needed in any one of our larger States. It is viewed solely as a beginning, and as the demand for service of this character grows the force must grow in size. Although I cannot speak with too much confidence of other States in this connection, I think I may speak for Pennsylvania on this point, and say that it will grow.

Why have not other States than those listed added extension foresters? It would seem that a number of them should have already done so. Is it because the State Forestry Departments have *not* felt kindly disposed toward the coming in of men not directly responsible to them, or has the demand for such service not been great enough as yet to justify the appointment? I view it that *we all, as foresters, regardless of whether we are working for the Nation, some State, some city or community, whether we are teaching forestry, or whether we are acting as forester to some private concern, are, first and foremost, engaged in "selling" the forestry idea to the people of the United States.* Perhaps as salesmen we have been failures. It would certainly appear that our advertising needs overhauling. We know now that our propaganda work has scarcely begun to take hold with the small land owner. Has too much of it lacked the definiteness which comes only with the field demonstration? I do not care to discuss at length the other supposition set forth—that the State Forestry Departments may not care to have extension foresters within their States—it hardly seems possible that such would be the case. May I just say that the Smith-Lever Act was planned for the purpose of carrying the results of experimental work out from the experiment stations to the farms—that it was, and is, essentially *educational;* that it was not planned to assume the prerogatives of any State Department of Agriculture, and, I feel I may

add, of any State Department of Forestry. It does not attempt to take charge of the forest fire protection work of a State, nor of its forest land acquisition and management, nor of any of the other usual work of a State Department of Forestry except that it offers to show farm owners and farm tenants what to do and how best to do it, provided they desire to be shown. Neither would we deny that a State Forestry Department has an educational duty to perform to all the citizens of the State. So have the United States Department of Agriculture and the United States Forest Service. I submit that there can be, and should be, the closest kind of cooperation between extension foresters and State Forestry Departments. I submit further that the particular agency which gives the farmer educational assistance on other lines on the ground should render assistance on the farm woodlot—that is, that the farm crops be treated as a unit, which is the farmer's way of looking at it.

ANALYSIS OF SOME PRESENT PLANS

Now let us look at some of the plans for work. Quite in the nature of things the assistance offered is of wide variety. Briefly, it may cover any one, or all, phases of forestry, from planting trees to assistance in marketing the crop. Referring to both New York and Pennsylvania, we may say that the work is divided into three heads—forest planting, stand protection and improvement, and marketing assistance. Under the first head we would include inspecting the land to be planted, helping the man to order and secure his trees for planting (an easy matter in Pennsylvania, since the State furnishes planting stock free of all cost except crating and transportation) and showing him how to plant, followed by occasional inspection to see how the plantation is doing. Under the second comes, of course, cleanings, thinnings, liberation, and damage cuttings, the cutting of fire lines, insect and disease control. Under the third come marking the stand, rough estimates, sale, and removal.

So far as possible, the group is dealt with rather than the individual: cooperative action is favored. We will work with an individual, however, when his problem is of such a character that it can be solved only on the ground, or when it seems wise to do so that the idea may thereby get a start in his community.

The work first attempted within a community depends partly upon what seems to be the greatest need, but partly also upon that phase

which seems to offer the best opportunity of gaining the interest, and the approval of the land owner. In Pennsylvania, planting seems to be the "open sesame" at the present time.

One question we had to settle short off was whether we would agree to make detailed timber estimates for our farmers. It was decided *not* to do so except in very unusual cases. Quite commonly we find that the rough estimate is all that the applicant needed; if for some reason or other he still desires a detailed estimate, there is given him a list of men who can do the work for him. The real test of whether the work is, or is not, extension in character, is its educational value. We do not set out to do the work for any man, but to teach him how to do it for himself.

ORGANIZATION

At the risk of covering information already well-known to you, I shall sketch briefly the type of organization. The farmers are organized under what is known as the Farm Bureau. The county agent is the executive of the Farm Bureau. He may or may not be appointed by the Farm Bureau, but in any event he is responsible not only to the Farm Bureau, but also to a central agency at the State College or University. This directing agency is the director of extension; sometimes he at the same time fills another position; for example, dean of the agricultural school. He is assisted by specialists for various lines of endeavor. These specialists are responsible for the several lines of work in the field, working with, and through, the county agents. That the county agent may do his work more easily, he organizes his county on a community basis, putting as good a man as he can find at the head of the project in each community. This community organization represents to my mind real organization for getting work done. To be sure, the leaders must have assistance at frequent intervals. No one expects that the usual community leader can handle the work as well as the county agent, or the specialist could, but considering the magnitude of the field each is expected to cover, it is apparent that only as they can succeed in passing on a part of their work in this manner, can they really get results. Coming down to specific cases, we at the present time have serving as community leaders of forestry projects in Pennsylvania graduates of the two-year course in agriculture at the college, men who have had the winter course of twelve weeks at the college, Boy Scout executives, farmers who have never had an hour's

instruction in forestry inside a classroom, and we will soon have—if we do not already have—men who have graduated in the four-year courses in agriculture.

DIFFICULTIES

One of the difficult points arises in getting any work started in a given community. There must be one landowner sufficiently interested that he will request assistance, or who, when solicited by some agency, will accept service and follow up the proposition. This is the first task to be done. This is just where the general propaganda work fits in; we cannot get along without it. Further than that, so far as the forestry work goes, I cannot see that it makes a great deal of difference where we start. The entering wedge is what counts. It may come through marketing assistance, through a thinning demonstration, or through planting. I do not mean by this that all communities will have the same needs. Most certainly not! In some there is one outstanding need, in others another. But it is all forestry, and it all leads to the same end, that of utilization of the non-agricultural parts of the farm for the production of a crop. Quite commonly the county agent finds that he can get attention to some phase of the forestry problem through some other activity. Through poultry, or hogs, or alfalfa, or one of a half dozen other things, he has made "contacts" and has gained the confidence of the farmer, so that the latter is open to suggestion with respect to the new line of activity. The fact that contacts are already existing is exceedingly important when it comes to the ease or difficulty of introducing new work. After a start is made in a given community, it is commonly not so difficult for a wise county agent to swing attention to that activity worst in need of attention. Getting the first "contact" is what counts.

Another difficulty that confronts us right now, and which is increasing, is the absence of specific data to answer certain questions put to us by the land owners. One dislikes to be saying continually that he doesn't know, in addition to which it isn't helpful to the practice of forestry. Earle H. Clapp has outlined the need for forest experiment stations in the United States in Circular 183 of the Office of the Secretary of the U. S. Department of Agriculture. William B. Greeley, U. S. Forester, says in his 1921 report of the U. S. Forest Service: "This work is just as basic to successful forest production in the United States as is the work of agricultural experiment stations to better farming." One could not state the need too strongly, in my

judgment. So far as our extension work is concerned, we certainly cannot take out to the farm woodlot owner information which, through absence of research, we do not possess.

RESULTS

In extension work it is difficult to gauge your results. Many times one finds that the very piece of work he had counted on to bring big things is most barren of results, while that piece of work which seemed at the time so little worth while has returned many hundred per cent on the effort expended. In this respect, of course, the work resembles closely other educational work. Above all, we need not look for the work to be done in a year or two. Impossible! G. H. Collingwood, Extension Assistant Professor of Forestry at Cornell, in his report for the year ending November 30, 1921 (as yet unpublished), says: "The regard for the farm woodlot and for forestry in general as covered by this farm forestry project has undergone no material changes during the past ten years. In spite of the efforts of the Department of Forestry here at Cornell, the College of Forestry at Syracuse, and the Conservation Commission the problem of the owner of farm woodlands of farm lands of non-agricultural value, have been scarcely scratched." Mr. Collingwood could well have included Pennsylvania with New York in this connection. The farmers of these two States are conservative, but they are rapidly growing less conservative.

Extension work in many other lines of farm activity has been going on for several years, and yet not nearly all the farmers are following the new practices. Judging by these other lines, in Pennsylvania it will take a thousand planting demonstrations, at least that number of improvement cutting demonstrations, and an unmeasured quantity of marketing assistance before we can really see that we are getting anywhere.

The lack of time forbids our considering results in detail of a given year's work. You will find Mr. Collingwood's report for the year just closing very interesting. In Pennsylvania we have not yet been at work a full year.

I's it worth what it costs? If the organization existed merely to do the work for the woodlot owner I'd say "No." But since it exists to help him to help himself and to help his neighbors, I say "Yes" unqualifiedly.

What are the big results to be expected? That farm woodlot owners will take better care of their woodlots, so that finally we can approve their forestry practices? Will they increase their production? I feel sure of it. But this, big as it may be, is far from being all there is to it. Speaking for the country as a whole, these hundreds of thousands of owners—all who give intelligent care to their collective millions of acres of woodlots—will be placed, fairly and squarely, behind the State and the Nation in movements for the wiser handling of forest lands *not* on the farms of the country. We may fairly expect such a result without being accused of being visionaries.

THE WEEPING HEMLOCK[1]

By H. S. Newins

Professor of Forestry, Oregon Agricultural College

Twenty miles west of Corvallis, Oregon, and about one mile beyond the crest of the Coast mountains (on the seaward slope), 50 feet west of the center of Sec. 11, T. 12, S. R. 7 W. W. M., there stands a western hemlock (*Tsuga heterophylla*, Rafn, Sarg.) singularly marked by its "weeping" foliage. The tree is located upon the east bank of Spencer creek, at an elevation of 800 feet above the sea, and perhaps 50 feet above the level of the river. On its north a small stream tumbles westward to the river about two chains beyond. The forest is of virgin character and is composed of Douglas fir, hemlock, western red cedar, western yew, red alder, and vine maple. The onward march of time is clearly emphasized by large standing butts of Douglas fir averaging over 100 inches in diameter, and by the surrounding trees of a younger generation. Because of the rough topography the individual trees stand out prominently with an abundance of space for the full development of their crowns. The soil in the vicinity of the weeping hemlock is a rich alluvial deposit covered with several inches of humus. Soil moisture is plentiful at all seasons. The average annual precipitation at the nearest station (Corvallis) is 42.76 inches (32 years) and the normal monthly mean temperature is 51.7° F. The site under description, however, is located in the Pacific coast humid area of the Transition zone, and consequently receives greater rainfall. There is no evidence of recent fire damage and the forest appears to be normally resistant to insect and fungus depredations.

DESCRIPTION

The weeping hemlock under discussion is a tree 114 feet high and averaging 19 inches in diameter at breast high. Its age is approximately 75 years as determined by the increment borer. The exposed superficial roots at the base of the tree, the thin bark, the petiolate leaves,

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[1] Read before the Forestry Section of the American Association for the Advancement of Science, Dec. 28, 1921.

and the cones which are borne in abundance, are all true in appearance to the typical hemlock trees which are so plentiful in this region, but the form of the crown is absolutely contrary to expectation, and, to say the least, is unique. The foliage of all hemlocks has a tendency to droop somewhat but with this individual there are no wide, spreading branches; instead the tree raises its lofty shaft directly from the ground and it is scantily, but most artistically, clad with closely appressed, irregular sprays of slender pendulous foliage. These sprays are attached to a main stem, eight to ten feet long, and varying from one-fourth to one inch in diameter. It is this character which gives the tree its "weeping" habit.

The lowermost branches are within reach from the ground. Here they extend perhaps ten feet out from the base of the tree, and from this point upward the branches extend outward at gradually lesser distances until the crown culminates in the nodding "leader" so typical of all hemlocks.

These sloping limbs are depressed at such an angle that it was with much difficulty that an experienced student while on a field excursion, and equipped with climbing irons, could ascend the bole a sufficient distance to collect ripened cones.

DISCUSSION

The people in this vicinity have long known of the tree. In the nearby town of Alsea it has already been the subject of significant verse.

In the more technical sense, however, this particular form of western hemlock has not been noted before. It is interesting then, to consider its possible origin. The above description shows that there is no evidence in the stand of an abnormal disturbance of the soil, or atmospheric factors. Such disturbances, where they do occur, may seriously change the architectural forms of trees. Wind blown specimens of *Cupressus macrocarpa* on the California coast present abnormal and fantastic forms. Jepson (*1*) shows how changed light conditions in the forest may often affect open stands of coast live oak (*Quercus agrifolia*) in the valleys so that they produce some trees which exhibit a disposition to develop pendulous sprays. He also illustrates the exceptional tendency of Douglas fir (*Pseudotsuga taxifolia*) to produce pendulous cord-like branchlets in response to disturbed nutrition or pathological causes.

By minimizing the importance of environmental factors in this particular case, it is possible to conclude that the weeping hemlock has developed through inherent disposition. This tendency toward seminal variation is not uncommon in the nursery where valuable forms are sometimes discovered for use in ornamental practice. Notable among these may be included *Picea nigra doumetii* (*2*), characterized by a narrow and very compact head, first observed in 1835; *Abies balsamea hudsonia* (*3*); and *Abies concolor fastigiata* (*4*). The last named appeared in France a few years prior to 1900 in the nursery of Thibault and Keteleer at Sceau, near Paris.

Then there are those forms which have been discovered growing in the forest and whose strains have been perpetuated in private and commercial gardens; *Picea exelsa virninalis* (*5*) was first discovered by Alstroemer in 1777 near Stockholm. This form has since appeared from time to time in the forests of southern Sweden and different parts of Germany. These trees are called snake spruces because of the remarkable and peculiar habit of the long slender and remote branches which are usually pendulous and are nearly destitute of lateral branchlets, and covered with closely appressed leaves and elongated leading shoots.

G. K. Gilbert, of the United States Geological Survey, observed in 1908 a weeping "tamrac" pine (*6*) (*Pinus murrayana balf.*) in the Sierra Nevada mountains at Blaney Meadows on the south fork of the San Joaquin River.

In 1909 a seminal form of *Picea canadensis* (*7*) was found in Canada about 100 miles north of Winnipeg. At the time this tree was described as being about 60 feet high and with its lower branches at least 20 feet from the ground, and marked with pendulous branches six feet or more long, slender, and but little branched.

A review of all available literature seems to indicate that there have been no forms of *Tsuga heterophylla* previously described. Sargent refers to variation in *Tsuga canadensis* (*8*) as follows:

"The abnormal cultivated forms of *Tsuga canadensis* are distinguished in some cases by a dwarf and compact habit, in others by fastigiate branches and by unusually broad or narrow leaves, or by foliage slightly marked with white. About eighteen of these forms are cultivated, but none of them has any particular beauty or value. (See Beissner, Handb. Nadley., 402; Sudworth, Bul. No. 14, U. S. Dept. Agric. Div. For., 42.) More distinct is a variety with short pendulous

branchlets forming a dense cushion from two to three feet in height and twenty feet across, which was found about 30 years ago in Fishkill Mountains in New York, and which introduced into gardens by Henry Winthrop Sargent, is occasionally to be seen in American collections, where it is usually known as 'Sargent's hemlock.' "

On October 13, 1921, seeds were collected from the weeping hemlock for experimental use at the nursery of the School of Forestry of the Oregon Agricultural College. Other experiments concerning the propagation of this tree will be carried on. It is unfortunate that the genus *Tsuga* cannot be more readily propagated by vegetative methods. Were this possible, this identical strain of the weeping hemlock, except for possible "clonal variation" (*9*), could be permanently maintained. *Picea nigra doumetii* may produce a whole colony of young plants about the parent tree by the vegetative reproduction of its lowermost procumbent branches as they touch the ground and throw out roots. Varieties of *Thuya* can be propagated by cuttings made from young branches.

CONCLUSION

Although these notes may have no immediate practical significance in forestry, it is hoped that they can stimulate a discussion which may reveal the existence of other rare forms of forest trees, and a subsequent speculation as to their origin. In view of this possibility the writer suggests for the weeping hemlock described above, the technical name *Tsuga heterophylla flaccida*.

REFERENCES

(*1*) Jepson, The Silva of California, p. 44.
(*2*) Gard. Chron, ser. 3, xi, 81.
(*3*) Sargent, Silva of North America, XII, p. 110.
(*4*) Carriére, Rev. Hort., 1890, 137.
(*5*) Pinus virninalis, Alstroemer, Vet. A. kad. Handl. Stockh. 1777, 310, pp. 8, 9.
(*6*) Jepson, The Silva of California, p. 45.
(*7*) "A Weeping Spruce," Torreya, July, 1909.
(*8*) Sargent, Silva of North America, XII, 66.
(*9*) Mss., Localized Variation in the Developmental Potential of Plant Individuals. Henry Hartman, Asst. Prof. Pomology, O. A. C.

RESERVED AREAS OF PRINCIPAL FOREST TYPES AS A GUIDE IN DEVELOPING AN AMERICAN SILVICULTURE

By W. W. Ashe

Since the forest type is the exponent of site, the formulation of plans for the regulation of yield and the theory as well as the practice of silviculture can be most effectively furthered by a knowledge of the forest types of the region under consideration. In practice the regulation of yield is a matter of policy and economics; in theory, however, regulation provides for the cutting of timber at the moment when the stand or certain portions of it may be pronounced ready for the ax. Thus it becomes the auxiliary if not the complement of silviculture, the practice of which may require modification to meet the exigencies of regulation. However woefully deficient the practice of American silviculture may be at present, it is not without hope, but the fulfillment of that hope though deferred will in large measure depend upon the knowledge of the original forest types of the region.

Where these types are few in number and formed by few species, there will be little difficulty in determining their original composition, however thoroughly this may have been obliterated by fires or by repeated cutting, with the resulting changes in composition. But in those regions where the forest types are involved, because of multiplicity of species or of variation in site, the mental reconstruction of the primitive forest types and the determination of the quality site as a basis for developing the ideal stand best suited to this site will be most difficult.

There will probably be four stages in the development of a distinctively American silviculture: (1) The assurance of protection where this is a prerequisite; (2) discarding the influence of European practice; (3) development by local men of primitive regional practice; (4) systematization of such practices into definite codes.

As the regional practice develops it may lead us far afield. It must be suited to economic conditions as well as to the region. On account of dissimilar conditions, economic as well as forestal, the ultimate practice in different sections of this country may be as radically different as the German theory is from the French practice; but it is believed

that regional American systems will eventually be developed, and that they will be distinctive in their application of the fundamental natural laws of the forest to American conditions, as well as in their adaptability to the use of American appliances.[1]

Several fellings may intervene before it is possible to determine for a particular site the form and composition of the ideal forest (the figment of the ideal forest will be forever changing) and even under definite management each successive felling especially in a mixed stand such as characterizes the eastern forest formations accelerates the effacement of the original forest type. It is not to be implied that the original forest type represents in all cases the ideal stand, the perpetnation of which is the final objective; but unless the original forest type for a given site is known it will not be possible after passing through the storm and stress of the period of primitive practice to obtain, when the opportunity eventually comes, an adequate result—the ideal stand which correctly represents the possibilities of the site. The knowledge of the qualities of the site as expressed in the original forest type will be lacking.

In order to supply this knowledge so that it may be available when needed, it is believed (1) that the original forest types should be carefully mapped; and (2) that characteristic areas, *vestigial units,* of each type should be held for reference and as guides for future work.[2] Such

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[1] See: "Effect of Changed Conditions Upon Forestry," by the writer, JOURNAL OF FORESTRY, 17:6, 657, Oct., 1919. In sequence, the logging locomotive, steam skidder, motor truck and caterpillar tractor, each in its respective field, have reduced logging costs—and have come to stay. Our silviculture must be developed to provide for them. To this end, at least in the Appalachians, a system of strip or group felling will, it is believed, ultimately be developed, perhaps some modification of the intensive practice of Duesberg (Der Wald als Erzieher, p. 99 et seq.) as suggested ten years ago by the writer in a Ms. report on yellow poplar. While to reduce fire hazard fellings will begin at the heads of streams and recede down stream, securing the protection afforded by green timber. Thus, at any stage lands already cut over can be isolated from uncut lands.

[2] The Ecological Society has initiated a movement for preserving natural areas. Its original plans which have now been modified were too indefinite and narrow to meet the ultimate requirements of silviculture. For the needs of silviculturists, as well as of biologists in general, an attempt should be made to preserve in its elemental integrity at last one unit of each recognized forest type, so situated as to be accessible for study. The writer in the winter of 1915, with a view to the preservation in their natural state of certain forest types, arranged with the owner of a large tract offered to the United States for purchase for National Forest purposes under the Act of March 1, 1911, to leave a strip of forest along the trail up Mt. Mitchell on the north slopes (Black Mountains, Pisgah National Forest), this strip including a number of forest types in their natural state and extending from the yellow poplar types at the foot of the mountain on the north slope to the red spruce below the summit. This purchase was never consummated, however, and this timber was cut. See JOURNAL OF FORESTRY, May, 1921, p. 262.

vestigial units (1) would serve as check plots for the forester; (2) would preserve basal forest data, of herbaceous as well as of ligneal species, for the biologist; (3) could be utilized as sanctuaries and breeding places for birds and small game; (4) would serve as small recreational areas of special interest to the nature lover.

In the following tabulation of 47 of the most important forest types in the Appalachians [3] an attempt has been made to locate characteristic vestigial units in which the type can be studied in its primitive state as least modified by human agencies. In several instances, however, the desire to locate these units in groups so as to be either contiguous or in proximity and to limit them just to a few National Forests has resulted in the selection of areas not fully representative. It should be remembered that each forest type in a mountainous region merges into that above it as well as into that below it, and as aspect, altitude, drainage, and soil change there is a zone of tension and a transitional type.[4] The percentage of National Forest area given as being occupied by each forest type is based on about 1,800,000 acres in the eight National Forests in the Appalachians and includes the transitional types as well. The salient consideration in selecting these units has been that each represents a generally distributed and sharply marked forest association, and so far as possible each unit has been located as a nucleus near the center of the distribution of the type which it represents.

The quality sites are based on intervals of 25 feet in the heights of the trees, beginning at quality 5 (height 25 to 49 feet) for the lowest. Each quality site is regarded as a distinct forest type.

The following letters are employed to designate the character of the distribution: G, general distribution and occupying large areas; P, of general distribution but occupying small areas of a few acres or less than an acre; L, local, as limited to mountain summits or a few soils; LP, local, even within restricted areas.[5]

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[3] This is summarized from a paper by the writer on the "Forest Types of the Appalachians and White Mountains," Journal Elisha Mitchell Scientific Society, Vol. 37, Nos. 3 and 4, March, 1922. The numbers assigned to the types are the same as those in that paper.

[4] The more simple distribution of forest types in a region of low relief is shown in Bul. 24, N. C. Geol. Survey, p. 14 seq.

[5] For assistance in the location of these vestigial units, I am under particular obligations to Forest Supervisors Verne Rhodes of Asheville, N. C.; S. H. Marsh of Harrisonburg, Va., and B. M. Lufburrow of Moulton, Alabama.

Important Forest Types in the Appalachians.

CANADIAN LIFE ZONE.

	Name of type	Per Cent of National Forests	Location of Vestigial Unit
1–4	Red spruce, qs. 2, 3, 4, 5; L	4	Eastern slope of Black Mts., Pisgah National Forest.
6	Southern balsam, q. 4; L	2	Eastern slope of Black Mts., Pisgah National Forest.

ALLEGHANIAN AREA OF TRANSITION LIFE ZONE.

	Name of type	Per Cent of National Forests	Location of Vestigial Unit
1	Chestnut pure, q. 2; G	2	Spicer Cove of Big Ivy Creek, Craggy Mts., Pisgah National Forest.
2–4	Chestnut pure, qs. 3, 4, 5; G	18	Eastern slopes Black Mts., Pisgah National Forest.
5–7	Chestnut oak pure, qs. 3, 4, 5; G	10	Ramsey Draft, Va., Shenandoah National Forest.
8–9	White oak pure, qs. 2, 3; G	6	Foothills, Potomac division, Shenandoah National Forest.
10	Spanish oak,[6] q. 3; G	6	Pink Beds, Pisgah National Forest.
11	Scrub oak, q. sub 5; L	2	Head of Ramsey Draft, Va., Shenandoah National Forest.
12–13	Yellow buckeye-sugar maple-yellow birch, qs. 2, 3; G	2	Peach Orchard Creek, North slopes Craggy Mountains, Pisgah National Forest.
14	Black cherry-black birch-yellow birch-sugar maple, q. 2; LP	2	North slopes of Craggy Mt., N. C., Pisgah National Forest.
15	Mountain lin-yellow buckeye-ash, q. 2; G	1	North slopes of Craggy Mt., N. C., Pisgah National Forest.
16–17	Yellow poplar-chestnut-northern red oak-hemlock, qs. 1, 2; G	5	Olmsted Lands, Graham County, N. C., Pisgah National Forest.
18	Yellow poplar-white oak-black gum-red maple, q. 3; L	1	Pink Beds, Transylvania County, N. C., Pisgah National Forest.
19	Yellow poplar-white oak-black maple, q. 1; L	1	Bee Branch, Alabama National Forest.
20–21	Yellow poplar-white oak-black oak-white hickory, qs. 3, 4; G	2	Slopes above Bee Branch, Alabama National Forest
22–23	Northern red oak pure, qs. 4, 5; L	1	Head of Ramsey Draft, Va., Shenandoah National Forest.
24	Northern red oak pure, q. sub 5; LP	.0	Crest of Rabun Bald Mt., Savannah National Forest.
25–26	Beech pure, qs. 4, 5; LP	.0	Olmsted Lands, Hooper Bald, Pisgah National Forest, Head of Big Ivy Creek, Craggy Mt., Pisgah National Forest.

[6] *Quercus coccinea,* see article this journal, p. 233, April, 1916.

ALLEGHANIAN AREA OF TRANSITION LIFE ZONE.

Name of type	Per Cent of National Forests	Location of Vestigial Unit.
27 Beech-sugar maple-yellow birch, q. 3; P	.6	Peach Orchard Creek, Craggy Mt., N. C., Pisgah National Forest.
29 Hemlock-birch, q. 1; G	6	Neals Creek, Black Mts., Pisgah National Forest.
30 Hemlock-birch, q. 2; P	1	Highlands Plateau, Savannah National Forest.
31 Hemlock-birch, q. 3; L	.5	Ramsey Draft, Shenandoah National Forest.
32 Spruce pine pure, q. 4; L	1	Blue Ridge near Marion, N. C., Pisgah National Forest.
33 Mountain pine[7] pure, q. 4; LP	.5	Blue Ridge near Marion, N. C., Pisgah National Forest.
34 White pine pure, p. super 1; L	2	Shady Valley, Tenn., White Top National Forest; Boone Division, Pisgah National Forest.
35 White pine pure, q. 1; G	3	Carroll Creek, Boone Division, Pisgah National Forest.
36 White pine pure, q. 2; G	1	Ramsey Draft, Shenandoah National Forest.
37 White pine-white oak-chestnut, q. 1; G	2	Carroll Creek, Boone Division, Pisgah National Forest.
38 Black pine,[8] Spanish oak, q. 4; G	2	Ramsey Draft, Shenandoah National Forest.

CAROLINIAN AREA OF UPPER AUSTRAL LIFE ZONE.

1 Rosemary pine[9]-black oak-white oak, q. 2; G	4	Blue Ridge above Marion, N. C., Pisgah National Forest.
2 Rosemary pine-post oak, q. 3; L	.0	Oconee Co., S. C., Savannah National Forest.
3 Rosemary pine-blackjack oak, q. 4; L	1	Above Russell, Oconee County, N. C., Savannah National Forest.
4 Black oak-southern red oak-white oak-sand hickory[10] q. 2; G	1	Alabama National Forest (general).
5 Spotted oak[11]-black oak-northern red oak-chinquapin oak-southern shagbark[12], q. 3; L	.0	Alabama National Forest, North slope escarpment, Moulton road.
6 Chinquapin oak-small shagbark hickory-northern red oak-post oak-red cedar, q. 4		Alabama National Forest, Foothills and valley, North slope of escarpment, Moulton valley.
Miscellaneous types, especially on alluvials	4	

[7] *Pinus pungens* (see article "English Names of Trees," this journal, April, 1916, p. 233).
[8] *Pinus rigida* (see issue this journal, April, 1916, p. 233).
[9] *Pinus echinata* (see issue this journal, April, 1916, p. 233).
[10] *Carya pallida.*
[11] *Quercus shumardii* Buckl. (*Q. schneckii* Brit.) See Bul. Charleston Museum, 14:2. 9, February, 1918.
[12] *Carya carolinae-septentrionalis.*

On public lands which are already or eventually will be placed under management the forest types should be mapped with the utmost care, especially where this can be done before any general cutting and consequently while it is yet possible to determine the types with certainty. This policy should be extended to privately-owned lands also, whenever it is possible. When this has been done, the fundamental data will have been obtained on which those who come after us can base their work, perhaps finding it desirable to change radically the composition of the stand or to apply the refinements of silviculture as developed by experiment. The outlook is that in a few years all of our forest lands not specifically reserved will have been cut over. Only the vestiges of the forest primeval set aside for definite purposes will be left. Such remnants even in National Parks may or may not provide a full series of the important economic forest types. It is eminently undesirable that the development of American silviculture should be hampered by such a lack.

Before it is too late areas of each forest type should be set aside, when possible several together, selected while it is yet possible in blocks a square mile or more in extent and situated if not where least accessible at least where there is little incentive for mercenary exploitation. The setting aside of such vestigial units will assure that the normal forest associations, once standardized, can be carefully studied and employed for future reference and guidance. It will be possible to maintain in such reference units the autochthonous biota in its elemental purity, except as affected by internal or natural agencies. The fact that such units will not contribute directly to the yield of the forest and its income, even assuming the timber thereon to be a total loss, does not imply that they will be uneconomic. Their aid in determining the life history of the different forest associations which they represent and their value as guides in bettering the treatment of the remainder of the forest will far more than offset the possible loss in timber.

In a few years these units will afford the only remnants of the primitive forests and as check plots will preserve for the forester the data from which he has worked and to which he must refer continually for guidance in maintaining the balance between species. This in large measure will determine the successful management of the forests.

Because of the great number of species which compose them, the Appalachian forests present an intricate problem to the forester. The forester's object is to obtain from a given site the most valuable yield within the shortest time; that is, to gain the highest profits. To produce this result in the mixed stands of the Appalachian the primitive stand will be modified by artificial treatment with a view to developing conventional stands: In place of all-aged stands, the stands may be even-aged or in even-aged groups; the complex may be simplified, so far as the needs of industry require and the silvical conditions permit, by the elimination of slow-growing species (e. g. hemlock), of species of little value such as Spanish oak (*Quercus coccinea*) and black pine (*Pinus rigida*) and of such as are super-susceptible to disease (chestnut). Doubtless in time an incentive to form pure stands, possibly of conifers, will arise. The primitive areas will then indicate the limits of possibility in this direction, and where failure occurs, as inevitably it often will in the extension of pure stands to many sites, they will suggest the desirable association.

Each felling of timber in a mixed stand changes the proportions of the different species which composed the stand and which formed the natural balance. A change in the crown canopy of the superior stand is also produced admitting more light, promoting the circulation of the air, inducing nitrification and changing soil biology. These modifications result in a still further change in environment, indicated by an influx of shrubs and herbaceous plants foreign to the original type on this site. As yet very little is known about soils other than their mechanical and to a less degree their chemical composition. The soil biology, especially mycorrhizal and bacterial forms with other associated life, its relationship to the forest probably largely symbiotic, and its influence upon the soil solution are influential factors in determining the character of the stand, its rate of growth and the establishment of seedlings. In the absence of a vestigial unit for reference, the work of the forester in attempting to adjust conditions will be largely empiric, with waste in energy, in time, and in resources.

It is on the site as expressed in the forest type that the experimental silviculturist conducts his experiments, whether planting, in cultural methods as applied to the growing stand, or in the determination of yield. The practitioner for his part must be able to correlate the types studied with those under his care. Otherwise, the experiments have little value.

To the ecologist such vestigial remnants will always be of prime importance in the study of relationship between site and product. Their utilization as sanctuaries for birds and small game will become of increasing moment as the forest area shrinks and the natural breeding places of game are destroyed. In the State of Pennsylvania alone thirty game refuges have already been located, a large number of them within State Forests and one within the boundary of the proposed Allegheny National Forest. Sanctuaries of the same kind, at least for such animals and birds as are of protective value to the forest, should be one of the results produced by the setting aside of vestigial units.

These areas, unaffected by other than natural agencies—fragments of the wild wood restful to the eye and offering a natural charm in their unkept lure—would have an esthetic and sentimental value to the unscientific nature lover which could never be found in the economic forests of the future, subject to exploitation and cleanings, however valuable they might be for timber production.

In view of the importance, in connection with the future development of the forest, of preserving areas of each forest type, the writer wishes to urge The Society of American Foresters at the first opportunity to adopt resolutions requesting the location of such vestigial units on National Forests in the United States and on the Dominion forests of Canada and their withdrawal from exploitation. It is especially desirable that this should be done in the Appalachians, where the Government holdings of uncut timber land are very small and where the private commercial forest lands will soon be entirely cut over. There are no National Parks in this region and if such areas are to be preserved it largely must be through the medium of National Forests.

REVIEWS

Progress Report of the Results Secured in Treating Pure White Pine Stands. By Ralph C. Hawley, Professor of Forestry, Yale School of Forestry. Yale University Press, 1922. Pp. 33, tables 16.

With the increase in the practice of forestry in New England, data based on the measurement of sample plots are needed by the profession. The results given by Professor Hawley were based upon sample plots established by the Forest Service in 1905, largely on the recommendation of Professor Graves, then Director of the Yale School of Forestry. It is therefore quite fitting that the data should be published under the auspices of the school and, because obviously preliminary in character, it is manifestly unfair to be too critical of the results. But critical comment on the data as prepared may be of value: (1) The conclusions "that the values in the yield table in different ages and on different qualities of site are not in complete harmony with the natural development of pine stands" based upon the comparison of one small sample plot with yield tables prepared by Frothingham (page 10), while possibly true, hardly justifies conclusions. The data are insufficient. What the profession needs today in New England is data on thinned stands rather than on second growth stands which have never been touched. Therefore, it is fortunate that Hawley has devoted most of the bulletin to a description and discussion of the plots which have been thinned. A possible criticism of one of the original experiments (with which Hawley had no connection, since the plots were under the Forest Service at that time) is that rather than trying to prove or disprove the value of the Borggreve method of thinning, the objective should have been to get data on the recognized methods of thinning in general use in Europe, namely, grade "C" thinnings. There seems to be a lack of clearness in presenting some of the data. For example, under classification of the plots on page 10, No. 604 is apparently a thinned plot, but the reader is informed on page 13 and in Table 3 that no trees have been cut from this area. The author should have taken pains to always make it very clear which plots had been thinned; for example, in Table 6, on page 16, no mention is made as to which plots are thinned. The reader can puzzle it out, but this, of course, should be unnecessary.

The conclusions from the thinned and unthinned plots are as follows:

(1) The thinnings have reduced the number of trees per acre by percentages of the original numbers ranging from 67 to 77.

(2) The reduction in number of trees per acre has concentrated growth on fewer stems of larger average diameter and volume.

(3) Height growth has been stimulated as a result of the thinnings.

(4) The actual amounts removed in each of the thinnings are shown for each plot in board feet, cubic feet, and on a percentage basis in Table 14.

(5) The basal area per acre is considered one of the best indicators of the character of the thinning. Ultimately a standard basal area per acre can be established for each degree of thinning. After and as a result of each thinning the basal area per acre would be reduced to this standard.

(6) The annual growth per acre expressed either in board feet or cubic feet has been increased as a result of the thinnings.

(7) With a wood capital smaller than in the unthinned stand, a thinned plot gives a higher rate of increase on the invested capital.

(8) The decrease in wood capital resulting from thinnings would be of importance in lessening taxable values.

(9) The comparatively early financial return secured from sale of material removed in thinnings has a most favorable effect upon reducing the cost of growing a crop of timber as compared to the unthinned stand.

(10) The thinned plots are in more vigorous and healthier condition than the unthinned plot.

(11) Pine reproduction, mixed with some hardwood becomes permanently established as a result of heavy thinnings.

(12) Weighing all factors the C grade thinning is considered superior to the G grade or Borggreve thinning.

Objection might be made to some of the conclusions on the ground that they are well known and accepted facts and are, therefore, obvious platitudes, but when one considers the ignorance in this country in regard to forestry, it is hardly fair to criticize even such conclusions that on thinned plots there are fewer but bigger trees than on unthinned plots, and that, therefore, logging will be cheaper and the material better. On the other hand, the technical forester will probably feel that conclusions have been included which might have been omitted, as, for example, "these figures indicate that height growth may be influenced

by the silvicultural treatment." Who would doubt the truth of such a statement?

Hawley concludes that pine reproduction can be successfully secured by the shelterwood method, that hardwood reproduction will overtop a portion of the pine seedlings, so that one or two cleanings may be necessary, and that slash left in white pine stands will not greatly reduce regeneration. It is hoped that the Yale School of Forestry will distribute this interesting bulletin among forest owners in order that they may realize the value of thinnings in coniferous stands.

T. S. W., Jr.

Process Verbal Revision of Amenagement, Domaniale Forest of La Fuvelle.

A carbon copy of the above in English translation was presented to the United States Forest Service by the Hon. L. MacIntosh Ellis, Director of State Forest Service, New Zealand, under date of July 7, 1921. It has been made a part of the Forest Service Library.

This translation appears to be itself an abstract of a more bulky volume. The forest consists of 365.58 acres on which the stand is 53 per cent fir and 47 per cent spruce. The original working plan was the work of M. Broillard in 1857, at that time Garde General des Eaux et Forêts at Mouthe. The forest was first submitted to selection cuttings, but after 1858 it was treated as regular high forest supplemented by natural reseeding and "light thinnings." The rotation set in 1857 was 140 years divided into seven periods of 20 years each to which definite divisions on the ground corresponded. Revisions were provided for at the end of each 20-year period. Such revision was made in 1877 and modified in 1888. This procedure was to be followed from 1898 to 1917 also. In 1905 another revision was made. Apparently it was done by a man of biased judgment who severely criticized the counsels of the original plan and probable results from carrying them out, without himself having a sufficiently intensive first-hand knowledge of the conditions of the forest on the ground and the past conditions as recorded. "The method recommended in 1905, upsetting the wise prescriptions in force for 48 years was emphatically inspired by purely theoretical conceptions which did not suit the economic and cultural conditions of the forest and which could be summed up as the 'systematic liquidation of the large tree class in order to make the stand

capital function and respond to a greater assessment.' This formula is indeed very attractive at first sight, but it neglects to tell us how it will be possible to assure at the same time the perpetuity of the forest which after all is the primordial end of all management." The revision, approved June 19, 1913, returned to the policy prescribed in 1857 modified slightly in application to conform to the present forest conditions. For all practical purposes the stand is normal.

In 1857 the average annual yield was estimated at 36,730 cubic feet (35.31 cubic feet per cubic meter), with the added calculation that it should rapidly attain 40,960 cubic feet per year. The average annual yield of the 55 years, 1857-1912, has been 43,996 cubic feet, with a money value of $4,130.41 (at par exchange of 19 cents for the franc). This is at the rate of 120.32 cubic feet, worth $11.29 per acre per year.

Nine tables are given, although from the context it would appear that some others may have been included in the French version. The material inventoried in 1912, the volumes and values of ligneous products realized for 55 years, descriptive conditions of compartments, regulation by areas and periods as practiced in the past and to be carried out in the future, a special regulation for 1914-17 and for 1918-37, division of the stand into average and large tree classes, comparison of annual production realized before and after revision of "Plan of Management," comparison of normal stand in middle mountain region of Doubs (Rochjean) with that of this forest, and, trees and volumes by compartments are shown in tabular form. Certain curves are present for some of the blocks. These show graphically the very interesting changes toward normalcy which are possible in 55 years—especially in distribution of size classes.

In computing the "possibilite" or as we say the limitation of cut three interesting points stand out clearly. First, a "reserve technique" of 3,000 m.3 is arbitrarily deducted from the volume of the large tree class that is to be cut during one-third of the rotation. Second, the simplicity of the method used to arrive at the amount to be cut. The average tree class total volume exceeds the *normal* three-eighths of the total stand and the large tree class total volume shows an equal deficit from the *normal* five-eighths. (The derivation of these *normal* proportions is not clear. They appear to be results of previous experience.) One-half of the volume or 3,815 m.3 of trees 1.2 m. in circumference is transferred from average tree class to large tree class to reestablish the equilibrium of the standing stocks. (This would seem to result if

continued in a lowering of the average d. b. h. of the standing stocks.) Accretion at 1 per cent on large tree class less "reserve technique" for one-sixth rotation is added to this large tree class principal. This total is divided by one-third of the rotation to give the annual limitation from this class. To this is added one-half of the annual accretion at 2.5 per cent on the average tree class to accommodate the intermediate products which will be taken. It is assumed that the 3,000 m.3 "reserve technique" will be used in 24 years. Then the limitation becomes 730 m.3 plus 260 m.3 plus 125 m.3 or 1,115 m.3, equivalent to 39,370 cubic feet per year. The third interesting point is that careful numerical refinements and compound interest rates in computing accretion are conspicuous by their absence.

The normal limitation of 990 m.3 is divided into three parts, 560 m.3 to come from regeneration fellings, 200 m.3 from amelioration fellings and 230 m.3 from accidental products. Accidental products above this 230 m.3 will be charged against the "reserve technique" which thus bears the duty of a "regulation" and permits of the normal application of the prescriptions of the plan of management.

Allocation of the cut by period and block for both regeneration and amelioration fellings together with sufficiently explicit instructions for marking are supplied. In utilization an interesting point is that all windfall and dead trees throughout the forest must be marked first and the difference between this total and 230 m.3 in either direction attributed to the "reserve technique." The regeneration fellings are to be marked second and the thinnings last. *All trees* over 0.6 m. in circumference are to be considered in the marking.

A general map of the forest is attached. It shows roads, blocks, compartments, and the general shape of the country. It has been traced and the tracing is to be filed in the Washington Office of the Forest Service.

The points that are of interest to the American foresters are:

1. Results obtained by management.
2. The tabular data considered necessary in such a plan.
3. The "reserve technique."
4. The simplicity of cut computations.
5. The supplying of explicit marking instructions.
6. The fact that revisions to be of value must be made by competent foresters at least as familiar with the actual conditions of the forest as was the original compiler.

E. W. Hartwell.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

A Forest of Salzmann Pine

Salzmann pine is a species of very limited distribution and mediterranean characteristics. On the warm, dry slopes of the little mountain range of Saint-Guilhem-le-Désert, where it is the only tree of particular interest, it now forms a forest of 470 hectares. This forest is unique of its kind and harbors a flora and fauna of remarkable richness and variety. Since its submission to the forest régime in 1843 its production has been practically nothing. Improvement cuttings were authorized in 1850 but were never carried out. In 1871 the tapping of the pine for turpentine was considered but the project was abandoned for lack of funds. Repeated requests by the local authorities to permit the grazing of goats were refused, and in 1898, following the acquisition of the forest by the State, even sheep grazing was prohibited. The long struggle over the grazing question aroused the ill-will of the local population and resulted in a number of incendiary fires. During the 47 years from 1851 to 1897 there were 6 fires which burned over 70 and completely destroyed 46 hectares; while during the 22 years from 1898 (the year the forest was acquired by the State) to 1919 there were 11 fires which burned over 1,237 and completely destroyed 341 hectares. Fire, the most serious enemy of the forest, when fanned by the mistral is practically uncontrollable and is not stopped by trenched fire lines. It can be kept out only by the acquisition by the State of the adjacent privately-owned lands, at least on the northwest. The reconstitution and expansion of the forest which should rapidly follow its protection in this way, and which should be hastened by planting, would make it a joy to botanists and entomologists. S. T. D.

Nègre. M. *La région de Saint-Guilhem-le-Désert et sa forêt de pin laricio de Salzmann.* Rev, Eaux et Forêts, 59: 97-108, 129-133. 1921.

SOIL, WATER, AND CLIMATE

The Humic Acids

This book is supposed to be preliminary to a handbook on the subject, but the reviewer declares that it is too early to write such a handbook, because of the incomplete state of our knowledge. The work of Wiegner covers very well the field of physical

effects of the humus, as well as colloidal chemistry, and the more recent work of the Bremen Moor Experiment Station has fairly well covered the effects of humus on the microbiology of the soil, except that neither the relation of the micro-organisms to the formation of humus, nor the properties in humus which act on microbes, are yet understood. But the chemistry of humus is almost an unknown field, in the scientific sense. The problem is to determine the chemical structures of the humus bodies, and to do so requires that chemically pure humus be isolated. Odén's whole work is of dubious value, because he neglected to make sure that his material was pure. For the same reason, his investigations in colloidal chemistry, and his attempts to determine degree of humification by colorimetric methods, are not reliable.

W. N. S.

Süchting, H. Rev. of *(Odén, Sven.—Die Huminsäuren. Chemische, physikalische und bodenkundliche Forschungen.* 199 pages, 21 figs. Th. Steinkopff, Dresden and Leipzig, 1919). Forstwiss. Centralbl., 43: 230-234. 1921.

Soil Expectation and Forest Expectation Value Theories

Two distinct doctrines have been advanced in the efforts to determine the most appropriate system of forest management; the one considers the soil alone as the fixed capital and endeavors to secure the highest possible interest on this soil capital, while the other considers the forest itself and the soil as an economic unit, which serves as the invested capital. Both systems are described with the formulae ordinarily used to calculate the soil expectation value (König-Faustman formula) and the forest expectation value, and the author, in detail, attacks the principles upon which the former is based; the so-called "addition" theory (Zurechnungs-theorie).

The soil capital theorists in short consider the forest, not as a united organism, but as the sum of individual parts. This conception is arbitrary and impracticable, and not in keeping with the peculiarities of forest management. The conception always presupposes the bare soil as the starting point which is the case only very rarely. As far back as history takes us, our forests existed as virgin forests and we can anticipate an uninterrupted continuity in the management of our forests in the future, which is only possible in the existence of normal forests. It is not possible to separate the factors involved in a productive process, as found in the forest industry, and to ascribe to each factor its pro-

portionate share of the final yield. In the process of production we do not deal with the sum of the processes but with one final product. Particular difficulty in the application of the König-Faustman formula, is experienced in the selection of the interest rate. In order to secure any satisfactory results, its adherents have been forced to use very low interest rates.

The forest expectation value adherents consider the forest and the soil with other factors, such as buildings, etc., as fixed capital, and not the soil as invested capital and the other as circulating capital. A sustained annual yield and continuous management are provided for, which is really compatible with existing conditions. Difficulties are also encountered in the application of this formula but the theory of highest interest on capital value of the forest and soil provides the best expression for the utilities which the forest provides its owners.

The author emphasizes the point that it is impossible to calculate for a standing forest a separate yield producing value for the soil and for the wood or to proportionately divide the yield to cover the soil and the wood supply. J. R.

Rothkegel, W. *Kritische Betrachtungen zur Bodenreinertrags und Waldreinertragslehre.* Zeitschr. Forst.-u. Jagdw., 52: 457-477, 1920.

SILVICULTURE, PROTECTION, AND EXTENSION

Spacing Conifer Plantations

The school of foresters in England who advocate fairly wide spacing of conifers seem to have won out. While admitting the silvicultural advantages of close spacing, if followed by early thinnings, the emergency of expensive labor for forestation and for thinnings coupled with the excellent results from widely spaced plantations of rapidly growing conifers has led foresters to recommend spacing species like Douglas fir about 8 feet on good soil and 6 to 7 feet on poorer quality. The most convincing statement is by Sir Henry Hoare who got the best results on good soil by spacing 8 feet. In a plantation spaced 4 feet Sir Henry lost 40,000 trees in patches of one-fourth to one-half acre owing to snow break. Brigadier General Stirling believes that the technical problem of spacing has not yet been solved for Great Britain, and that experimental plots should be established "each of one-tenth of an acre, planted at distances of 3 feet, 3 feet 6 inches, 4 feet, 4 feet 6 inches, 6 feet, and 5 feet 6 inches." Probably wider

spacing should also be experimented with and certainly one-tenth of an acre would be insufficient to give accurate results; the plots should be at least one-fourth acre in area and preferably larger. Anderson gives a splendid summary of the continental literature on spacing. The data are systematically arranged and unquestionably contain much of value to the teaching profession. Generally speaking, Anderson believes that close planting is preferable on poor soil or soil with heavy vegetation where very small plants or slow-growing species are used, or where natural pruning is of essential importance. Open planting is advocated on the more fertile soil with rapidly growing species, and where natural pruning is not essential. Even Anderson recognizes that the general trend throughout the forestry world is toward wider spacing.

T. S. W., Jr.

Leven, George. *Discussion on Planting Distances.*
Brigadier Stirling. *Planting Distances for Douglas Fir.*
Anderson, Mark L. *On Planting Distances for Conifers.*
Honorary Editor. *Planting Distances.*
Hoare, Sir Henry. *Planting Distances for Douglas Fir.* Transactions R. S. A. S., 35: 1-28, 76-77, 1921.

Evaporation and Forest Fires

Various attempts have been made to correlate fire phenomena with the various climatic factors. The relation between the two has long been noticed. It now appears that evaporation bears a close relationship to occurrence of forest fires and for two years' data in California there is a consistent correlation.

In a large district, such as California, the number of fires which start on any particular day does not vary greatly after the fire season has really begun. But the proportion of fires which become large is not a constant, and varies with a number of factors such as location, vegetative cover, and weather conditions. Excluding factors brought about by the human equation and location, the size of a fire depends on weather conditions to a large extent. Some fires may burn for several days without spreading more than a short distance, while others in similar situations burn and spread rapidly. The difference between the intensities of these conditions is expressed in the difference in the rate of evaporation, for it has been found that periods of low evapora-

tion are the periods during which most fires are controlled while they are still small. In periods of high evaporation the fires frequently cover large areas.

The evaporation data on which the studies were based were taken in the southern part of California in 1915 and 1916 and it would be expected that the major correlation between fire and evaporation would hold in that locality. In the period from June to October, 1915, inclusive, 12 periods of marked high evaporation occurred and the fire data for the three southern California National Forests show that Class C fires of over 300 acres occurred in ten of these periods and fires of over 1,000 acres in four out of six of the very high periods of evaporation. In 1916, 10 periods of high evaporation show 10 periods in which fires of over 300 acres occurred, and out of five periods of very high evaporation fires of over 1,000 acres occurred in four.

Considering the individual fire, it was found that the largest fires or those most difficult to control have occurred during periods of high evaporation, and that the catastrophes which have occurred in California in recent years have taken place during periods of high and long continued evaporation. Such a period occurred from the 17th to the 27th of September in 1919, during which 10 per cent of the Angeles National Forest was burned over.

The correlation holds not only in the southern part of the State, but also in the northern. The same periods of high evaporation are the periods of large fires, and, conversely, the periods of low evaporation rate are periods of small fires.

If the changes in evaporation could be forecasted in advance it would be a long step in preparation for the emergencies when large fires suddenly occur simultaneously over a large area. J. K., Jr.

Munns. E. N. *Evaporation and Forest Fires.* Monthly Weather Review, 49: 149-152. March, 1921.

Local Occurrence of Beech in Germany

The range of beech is discussed together with its local occurrence in Germany and especially in Brandenburg, and its relation to soil and climate. Until late in the 18th century, when all forests were selection forests, beech held its own with other species such as birch, aspen, pine, linden, and the oaks. It was cut extensively for firewood, and hogs and game ate the mast, thus gradually reducing its proportion in the stand. The clear-cutting

methods introduced later were not at first harmful to the beech, because cutting was not clean, and natural reproduction was relied upon; in the 19th century, however, closer utilization, artificial reproduction, removal of litter, and pasturage, resulted in the almost complete elimination of beech from many pine forests.—It should be restored, because of its value for maintaining favorable soil conditions and for checking wind movement and evaporation, and because it will increase the total yields per acre. Pine alone does not utilize the full productivity of the soil, but lets grass and brush come in to use up the plant foods; beech properly managed should add from 1 to 2 cubic meters of wood per hectare per year to the 5 or 6 cubic meters produced by the pine. The idea that beech helps to clean the boles of the pine is a myth.—Beech and pine are associated now mostly as (1) remnants of virgin forest; (2) older beech in even-aged younger pine stands; (3) approximately even-aged mixtures of pine and beech; (4) young beech under old pine. Such stands should always be managed so as to favor the beech in every way possible, both the existing trees and future reproduction. Hartig's serial-cutting method (preparatory, seed, light, and removal cuttings) does not result in satisfactory mixed stands; a selection method is better.—Attempts to restore beech to pure stands of pine should be confined for the present to fairly good sites where beech is reasonably sure to succeed. This can be done by sowing or planting both species practically together, before cutting off the old pine, thus getting an even-aged high-forest, with beech somewhat smaller than pine at maturity. The method is not generally recommended because unless the various operations are carried out at just the right times, either beech or pine is liable to be lost. It is safest where the pine will reproduce naturally. Another method is to underplant comparatively young pine stands with beech. This is not generally desirable, because the beech will seldom be merchantable by the time the pine is cut. A third method consists of growing even-aged beech-pine stands with older pine reserves. Here there is danger that the shade of the overstory will tend to favor beech reproduction to the detriment of the young pines. An all-aged mixed selection forest will be most favorable for the beech, but there are comparatively few real selection stands of pine. It may be possible to develop such stands by introducing beech in openings, or by underplanting it under young pine. A simple way to introduce species not already represented in a stand is to plant such trees as ash, maple, hornbeam, linden, oak, and beech along the roads, whence they will

gradually seed into the pine.—In general, the beech should be scattered singly among the pines, rather than in groups, and should be numerous enough to cover the whole surface with beech leaf-litter. About 100 average mature beech trees per hectare will do this. There should be as many pines as though no beech at all were present; since well-developed pines in high-forest have crowns 18 times as wide as d. b. h., there should be about 200 per hectare at maturity (120 years), when d. b. h. averages 45 cm.—Details of seed collection, storage, sowing and planting are described, as are also the protective measures required during the early life of the plantations. W. N. S.

Bertog, Hermann. *Die Buche im nordostdeutschen Kiefernwalde.* Deutsch. Forstzeitz. 36: 463-467; 566-568; 570; 585-589; 664-665; 679-683; 701-703; 754-757 1921.

The "Continuous Forest"

The author agrees with Wiebecke that "Dauerwald" is the same thing as selection forest (Plenterwald). Points in its favor are: aesthetic effect; less danger from fire; possibility of an annual timber crop, especially for small holdings; in case of natural reproduction, seed best adapted to the site; small expenditures for reproduction (but Junack does not agree that the Dauerwald idea necessarily means natural reproduction); increased growth. The scattering of branch wood helps reproduction and growth by maintaining a quiet and therefore more or less damp layer of air next to the ground, by stimulation of bacterial activity, and by helping to hold the CO_2 liberated by decomposition of the raw humus. This can be done on clear-cut areas also. The accuracy of Möller's figures on growth in the Bärenthorn forest is questioned.—Disadvantages of the method are: greater costs of felling, skidding, and supervision, together with lower sale prices, amounting altogether to a less net return by 50 marks per cubic meter; probable injury to young growth in logging; more limby young growth; more difficult to protect young growth against insects and game (but less liable to such damage); danger of impairing continuity of yield, if reproduction is slow to start; fewer thickets of young growth to hide game (locally important); gradual giving away of valuable intolerant trees such as pine before the less valuable tolerant species; in case of sudden general adoption, the flooding of the market with small material and scarcity of larger timber.—The author recommends: Scattering of branchwood in all cuttings, whether selec-

tion or clear cuttings; "Dauerwald" where aesthetic or protective considerations govern, also for small holdings where an annual return is desirable; in all other cases, and particularly in state forests, leave this method alone.

W. N. S.

Junack. *Vorteile and Nachteile des Dauerwaldes.* Deutsch. Forstzeitz. 36: 739-743. 1921.

Meteorology and Reforestation

Practically all of the streams rising in the Cévennes are subject of severe floods that frequently do tremendous damage. These floods are primarily due to the fact that during the summer the air overlying the comparatively exposed soil becomes superheated and consequently surcharged with water vapor, which in the autumn is suddenly precipitated by cold winds from the north. Sometimes this precipitation reaches 791 mm. in 24 hours, or more than the average annual precipitation in most of France. That lack of forest cover is largely responsible for this concentration of precipitation in the autumn is indicated by the fact that in the neighboring plateau of Lente and Vercors, where conditions are practically the same except that 38 per cent of the total area is forested as against 17 per cent in the Cévennes, the precipitation is much more evenly distributed throughout the summer. The forest, by preventing overheating of the soil and of the overlying strata of air, lowers the temperature and decreases the relative humidity, thereby inducing more frequent precipitation. It also materially moderates the force of the wind and by checking evaporation prevents the sudden cooling of the atmosphere. Finally, it greatly reduces erosion and regulates run-off. Reforestation of the denuded slopes of the Cévennes to a point where 38 to 40 per cent of the total area is under forest cover would be the surest, most permanent, and least costly way to lessen if not entirely to do away with the present torrents. Moreover, by increasing precipitation during the summer months, when it is most needed, it would decidedly improve cultivation and pasturage. Hardy pines would undoubtedly have to be used in the first plantings, to be succeeded later by fir and beech. There should be no delay in undertaking the work of reforestation, from which there is everything to gain and nothing to lose.

S. T. D.

Chaudey, A. *Météorologie et Reboisements.* Rev. Eaux et Forêts. 59: 239-249. 1921.

Conversion Into Selection Forest

Because of steadily diminishing financial returns from the described stand (coppice-with-standards, composed of oak, ash, birch, beech, linden, hornbeam, hazel, and poplar), it was decided to convert it into a selection forest, so as to produce more saw-timber. This was accomplished, first, by leaving it alone for several years, until the canopy had closed, then making a light improvement thinning, followed in about 8 years by another cutting, to increase the proportion of trees originating from sprouts and also to help the more desirable species. Natural seedling reproduction, especially of ash and maple, was fairly satisfactory, but was supplemented to a small extent by planting ash and other species. Conifers, including spruce, larch, and pine, are also to be introduced into the mixture. Financial returns began to increase as the proportion of branch-wood produced diminished. It is stated that basswood sprouts make saw timber in 40 years or less—in many instances the yield of wood and the financial return can be greatly increased by converting even-aged, pure stands into selection forest. Several examples are given of the different ways in which this may be accomplished. Essential features of all are the encouraging of natural reproduction, of the intermixture of other species, and the elimination of extensive clear-cuttings, but it is stated that the method should be adapted to the individual stand, and not attempt to follow any fixed rule. One pine stand is mentioned, now 100 years old, from which 6 selection cuttings during the last 24 years have removed 472 cubic meters per hectare, while 150 cubic meters is still left. As the stand 24 years ago contained 430 cubic meters, the average annual growth has been 8 cubic meters. W. N. S.

Sieber. *Überführung von Mittelwald und schlagweisen Hochwald in Blenderwald.* Forstwiss. Centralbl., 43 : 250-261. 1921.

Reproduction of Forests

Several new systems of silviculture have been proposed within the last few years, including the selection bordercutting (*Plentersaumschlag*) of Wagner, the method used by Eberhard at Langenbrandt, the Eberbach method and the so-called pine "continuous forest" form (*Dauerwald*) of von Kalitsch. Common to all of them are dependence on natural reproduction, and the elimination of clear-cutting. None of these methods have found much favor outside of the localities where they originated, although their authors have claimed great results

for them as contrasted with the old and still generally used method of clear-cutting followed by artificial reproduction. Reiss, after more than 50 years' experience in the pine region of the valley of the Main, explains why he believes that natural reproduction methods will not give as good results in pine, and even in oak forests, as clear-cutting and planting, except possibly under very special circumstances. He does not question the use of natural reproduction in silver fir stands.

W. N. S.

Reiss. *Natürliche und künstliche Bestandsverjüngung.* Forstwiss. Centralbl., 43: 201-219. 1921.

Protecting Forests

Large areas of beech forest north of Eisenach have been entirely defoliated by the caterpillars of *Dasychira pudibunda.* The Seebach forest, which is a bird refuge, stands out like a green island, having almost entirely escaped any damage, because before the butterflies could lay their eggs they were eaten by birds. W. N. S.

,Pd. *Waldschutz durch Vogelschutz.* Deutsch. Forstzeitz., 36: 731. 1921.

Experience With Strip Cuttings

As a result of his experiences with the method, the author concludes that cutting in strips (30 to 40 meters wide) has certain advantages in stands whose composition or location renders the danger of windfall slight. He favors reforestation by planting 3 to 4 year old twice transplanted spruce, spaced 1.5 to 2 meters each way, except when the cutting follows a seed year, when it is better to wait and see if natural reproduction will suffice. Pine and larch will reproduce naturally. In case of wind or snow damage to the old stands between the strips, do not clear cut unless more than half of the trees are so damaged that they must be removed. W. N. S.

Hann, R. *Erfahrungen mit Saumschlägen.* Forstwiss. Centralbl., 43: 237-239. 1921.

Origin of Forest Fires

Investigations carried on by Reinhardt during the periods 1904-1913 and 1918-1920 have brought out several conclusions that are contrary to what is generally believed. Fires are not caused by burning cigar stubs, pipe ashes, or glowing matches, but can start only when the match or cinder is burning with a flame. Still or

slowly moving air is most favorable for start of fires, but high winds cause them to spread, once started. W. N. S.

Schwappach. *Vorsuch über die Entstehung von Waldbränden.* Deutsch. Forstzeitg., 36 : 670. 1921.

Cypress at Mouth of the Rhone

Bauby gives data in regard to the growth of cypress and eucalyptus at the mouth of the Rhone. A small area showed a yield of 919 cubic meters of cypress per hectare at 55 years of age. The writer concludes that the species (with the eucalyptus) would be excellent for reforestation in this swamp country.

T. S. W., Jr.

Bauby. Ph. *Le Cyprés Chauve Dans Les Marais des Bauches Du Rhone.* Revue des Eaux et Forêts, 40: 1-10, 1922.

MENSURATION, FINANCE, AND MANAGEMENT

Financial Rotations in Public Forests

Bourne argues that the most profitable rotation, or the financial rotation, is the rotation of the highest income, *but with the "per cent" at zero.* He grants that all forestry textbooks instruct the student to figure interest on all items of revenue and expenditure, but he believes that "for the equalized annual working, or for a whole forest," this is not true. Where there is "a normal series of age gradations," it is argued that before being used for forestry, some of the land may be managed for profit (as for grazing or agriculture) and thus "redeem a part, or the whole of the capital cost." In applying his argument to conditions in the South Malabar Division, Madras, India, Bourne figures that even allowing 3½ per cent compound interest the average cost value per acre of government forest in 1920 was about $4 without crediting the returns already realized from the growing stock. Therefore, he argues that "the cost value of the soil may even be ignored." A very high rate of return is therefore indicated, this being an argument for further investments of government funds in forestry in British India. The article brings up the whole controversy as to whether it is necessary to charge interest rates to the investment after the forest is a going concern. But Bourne goes even farther than that when he argues that the soil and growing stock values of government forest in British India should be ignored in calculating financial returns.

Even with a fairly normal managed forest, the actual financial yield can only be figured by dividing the sale or appraised value of the land and growing stock into the average annual net returns. If no soil value at all or a partial cost value is used, the result is obviously open to question.

T. S. W., Jr.

Bourne, R. *A Dissertation Upon Forest Finance.* Indian Forester, 48: 1-14, 1921.

Subsidy for British Forests

On November 5, 1921, General Lord Lovat announced the following subsidies: "(*i*) A free grant of fixed sum for every acre planted this season by local authorities. (This grant will correspond approximately with the 60 per cent grant to the local authorities' labor bill allowed out of the fund of the unemployment grants committee.) (*ii*) A free grant of £3 for every acre prepared and planted by private individuals during this planting season, or, alternately, up to £3 per acre for land prepared for planting this season, but planted at some subsequent date. (*iii*) A free grant of £2 per acre for all approved scrub-clearing schemes, whether the scrub be cleared by the local authority to provide work for the unemployed or by the owner to provide land for planting."

T. S. W., Jr.

Lovat. *Forestry as a Means of Relieving Unemployment.* Transactions of the R. S. A. S., Vol. XXXV: 101-105, 1921.

UTILIZATION, MARKET, AND TECHNOLOGY.

Sales of Wood in 1920

Prices for timber, already very high in 1919, continued to rise materially in 1920. Oak averaged 125 francs per cubic meter in the log in the Parisian region; while in the forest of Bellème oak of first quality rose from 200 francs in 1919 to 325 francs in 1920. Other species, both hardwoods and conifers, showed similar increases but with considerably lower maxima. Fuel wood, on the other hand, dropped somewhat in price in 1920 as compared with 1919. The high prices for timber were due to depleted stocks; to reduced imports; to the anticipated renewal of economic activity; and to the generally increased prices for all commodities resulting from a depreciated currency. They will doubtless continue high if industrial and commercial conditions improve and if German reparations permit the reconstruction

of the devastated regions; and will fall with the disappearance of the cause that gave rise to them. While the present high prices are profitable for forest owners, it must be remembered that they hinder the reconstruction of the devastated zone and are likely to stimulate increased foreign and colonial imports. They emphasize the importance of forests in the general economy of a nation, and the wisdom of so handling them that they will be able to meet both ordinary and extraordinary needs. S. T. D.

Cardot, E. *Les ventes de bois en 1920.* Rev. Eaux et Forêts, 59: 109-115. 1921.

Wood as Construction Material

Owing to the scarcity of iron and steel, which previous to the war had gradually been taking the place of wood in building construction, wooden construction is going on in greater volume than ever before. Points in favor of wood are: its greater resistance to chemical action, its lighter weight, its greater ease of working, its non-conduction of heat and of electricity, its durability (when dry), its comparative non-inflammability (fair-sized beams resist heat sufficient to weaken iron girders, and when they do burn less damage is done to the masonry than where steel girders collapse). Recent investigations have shown how the use of "built-up" construction can combine great strength with economy of material, so that it has become possible to roof rooms up to 50 meters wide with wood (auditoriums, hangars, railway stations). It is stated that the 60-meter tall antennae supports at Munich are built of pitch pine, and were put up by one man without difficulty. W. N. S.

Fabricius. *Holz als Baustoff.* Forstwiss. Centralbl., 43: 268-270. 1921.

New Method of Tapping Martime Pine

A French commission has approved of new rules to govern the disposal of maritime pine turpentine rights. Points of interest to the United States are as follows: (1) The marking of pine to be tapped alive is to commence when trees reach a circumference of 3.4 feet, except in the protective zone along the ocean; (2) progressive light tapping in each lot is to be for a period of 12 years before commencing to tap to death. Light tapping is to commence when trees are 27.5 inches in circumference and in addition on trees that are to be removed by thinning; (3) tapping on

the same face is to last four years according to the following maximum dimensions:

Year	*Height, inches*	*Width, inches*
First	23.6	3.5
Second	49.2	3.5
Third	82.7	3.1
Fourth	118.1	2.7–2.4

(4) Sales will ordinarily be for a period of four years and should not exceed five thousand to fifteen thousand faces for trees to be removed in thinnings or 25,000 faces for tapping to be followed by clear cutting. Auctions will be held during the month of December and turpentine operations may commence January 20 and may continue up to November 30. The committee voted definitely not to take over the tapping work as a government function. T. S. W., Jr.

Revue des Eaux et Forêts, 60: 21-23, 1921.

MISCELLANEOUS

Swiss Forestry Association

The Swiss Forestry Association is not a strictly technical organization, but admits "friends of forestry" to full membership. The pace is set, however, by the professional foresters. The annual meeting with its discussions of some special topic and carefully thought out field trip is the great function, but the association also edits a technical journal in two languages, distributes prizes and carries out research. Continuity of policy is assured by an executive committee of five elected for three years. The budget for next year calls for about 14,000 francs, distributed as follows:

Receipts—	*Per cent*	*Expenses—*	*Per cent*
Dues of members	38	Publishing the magazine	69
Government subsidy	43	Committee expenses	14
Interest on invested funds	3	General administration	4
Special payments	16	Miscellaneous	13
	100		100

K. H. W.

Der Schweizerische Forstverein. Schweizerische Zeithschrift für Forstwesen. Sept., Oct., and Nov., 1921.

CURRENT LITERATURE

Compiled by Helen E. Stockbridge, Librarian U. S. Forest Service.

MONTHLY LIST FOR MARCH, 1922

(Books and periodical articles indexed in Library of U. S. Forest Service)

Forestry as a Whole

Proceedings and reports of associations, forest officers, etc.

Empire forest products association. Papers presented at the 16th annual meeting, Utica, N. Y., Nov. 10, 1921. 40 p. Albany, 1921. (Bulletin no. 12.)

India—United Provinces—Forest dept. Annual progress report of forest administration, for the period 1st July, 1920, to 31st March, 1921. 104 p. Allahabad, 1921.

Maryland—State board of forestry. Report for 1920 and 1921. 68 p. pl. Baltimore, Md., 1922.

Massachusetts forestry association. Twenty-fourth annual report. 16 p. il. Boston, Mass., 1921. (Bulletin 134.)

Missouri forestry association. Missouri forestry association, organized Dec. 7, 1921; constitution. 4 p. St. Louis, 1921.

New Brunswick—Crown land dept. 61st annual report for the year ended 31st October, 1921. 87 p. pl. Fredericton, N. B., 1922.

Rhode Island—Commissioner of forestry. Sixteenth annual report. 1921. 10 p. Providence, R. I., 1922.

Sweden—Domänstyrelsen. Kungl. domänstyrelsens förvaltning, år 1919. 158 p. Stockholm, 1921.

Forest Botany

Sargent, C. S. Manual of the trees of North America, exclusive of Mexico. 2d ed. 910 p. il., map. Boston & N. Y., Houghton Mifflin co., 1922.

Forest Mensuration

Winkenwerder, H., and Clark, E. T. Handbook of field and office problems in forest mensuration. 2d ed. 133 p. N. Y., J. Wiley & sons, inc., 1922.

Forest Protection

Fire

Coeur d'Alene timber protective association. Sixteenth annual report. 13 p. Coeur d'Alene, Id., 1921.

New Jersey—Dept. of conservation and development. Look out guide for New Jersey. 10 p. il., map. Trenton, N. J., 1922.

North Carolina—Geological and economic survey—Forestry division. Forest warden's manual, by W. D. Clark. 23 p. Chapel Hill, N. C., 1922.

Washington forest fire association. Fourteenth annual report, 1921. 28 p. il. Seattle, Wash., 1922.

Forest Valuation and Finance

Endres, M. Lehrbuch der waldwertrechnung und forststatik. 3d ed. 324 p. Berlin, J. Springer, 1919.

Forest Administration

Reisner, J. H. Progress of forestry in China in 1919-1920. 6 p. Marlboro, N. Y., 1921.

Forest Economics

Statistics

Canada—Dominion bureau of statistics. Lumber, lath, shingle, etc., 1919. 66 p. Ottawa, 1922.

Canada—Dominion bureau of statistics. Pulp and paper, 1919. 42 p. Ottawa, 1921.

U. S.—Bureau of the census. Forest products, 1919: forest products consumed in the manufacture of veneers, dyestuffs and extracts, and in tanning and wood distillation. 10 p. Wash., D. C., 1922.

U. S.—Bureau of the census. Forest products, 1919: pulp-wood consumption and wood-pulp production. 10 p. Wash., D. C., 1921.

U. S.—Bureau of the census. Forest products, 1919: tight and slack cooperage stock. 8 p. Wash., D. C., 1921.

Forest Maps

India—Survey of India dept.—Forest map office. India, showing forest areas and working plans on 30th June, 1919. Dehra Dun, 1920.

India—Survey of India dept.—Forest map office. India, showing government forests on 30th June, 1919. Dehra Dun, 1920.

Forest Utilization

Lumber industry

Müller, J. F., & sohn. Jahresbericht über nutzhölzer. 8 p. Hamburg, 1921.

Wood-using industries

Sackett, H. S. The use of southern yellow pine in car construction, with recommendations for the proper storage and handling of lumber and timbers. 55 p. il. New Orleans, La., Southern pine assn., 1922.

Wood Technology

Stone, H. A text-book of wood. 240 p. pl. London, Wm. Rider & son, ltd., 1921.

Auxiliary Subjects

Description and travel

Bell, P. L. Colombia: a commercial and industrial handbook. 423 p. pl., map. Wash., D. C., 1921. (U. S.—Dept. of commerce—Bureau of foreign and domestic commerce. Special agents series no. 206.)

Parks

Iowa—State board of conservation. Iowa parks: conservation of Iowa historic, scenic and scientific areas. 328 p. pl. Des Moines, Ia., 1919.

Reclamation of land

Ramser, C. E. Gullies: how to control and reclaim them. 44 p. il. Wash., D. C., 1922. (U. S.—Dept. of agriculture. Farmers' bulletin 1234.)

Bee-keeping

Phillips, E. F., and Demuth, G. S. Bee-keeping in the tulip-tree region. 25 p. il., maps. Wash., D. C., 1922. (U. S.—Dept. of agriculture. Farmers' bulletin 1222.)

Periodical Articles

Miscellaneous periodicals

Aerial age, Mar. 13, 1921.—Operation of aeroplanes over forested areas, p. 11.

Aerial age, Mar. 27, 1921.—Modern forest fire fighting, by P. G. Redington, p. 51.

Botanical gazette, Jan., 1922.—Yellow-pine formation at Little Manistee, Mich., by L. H. Harvey, p. 26-43.

Botanical gazette, Mar., 1922—Symbiosis in a deciduous forest, by W. B. McDougall, p. 200-12.

Cornell countryman, Dec., 1921.—A look ahead in forestry, by J. W. Toumey, p. 75.

Country gentleman, Jan. 28, 1922.—His Pennsylvania woodlot has paid for twenty-four years, by P. S. Lovejoy, p. 7.

Country life, London, Feb. 4, 1921.—The rating and taxation of woodlands, by A. J. Burrows, p. 153-4.

Country life, London, Feb. 18, 1921.—On yew hedges, by G. H. Kitchin, p. 212-14.

Garden magazine, Feb., 1922.—Trees destroyed by ice in New England, by T. D. Hatfield, p. 293.

Gardeners' chronicle, Feb., 18, 1922.—The Sitka spruce in Sussex, by A. D. Webster, p. 79.

House and garden, Feb., 1922.—The value of the ancient wood; some kitchen utensils of wood, by E. R. Peyser, p. 56-7, 62.

Journal of economic entomology, Oct., 1921.—Forest insect problem of the Pacific slope, by A. J. Jaenicke, p. 447-50.

Journal of ecology, Feb., 1922.—The woodlands of Ditcham Park, Hampshire, by R. S. Adamson, p. 114-219; Stratification and hydrogen-ion concentration of the soil in relation to leaching and plant succession, with special reference to woodlands, by E. J. Salisbury, p. 220-40; On the mycorrhizas of Pinus sylvestris L. and Picea abies Karst, by E. Melin, p. 254-7.

Journal of Indian botany, Sept., 1921.—Forest formations and successions of the Sat Tal valley, Kumaon Himalayas, by L. A. Kenoyer, p. 236-58.

Michigan agricultural experiment station. Quarterly bulletin, Feb., 1922.—The station's white pine plantation, by A. K. Chittenden, p. 105-6; Woodlot or sugar bush, by P. L. Buttrick, p. 107-8.

Missouri botanical garden bulletin, Feb., 1922.—The Daniel Boone judgment tree, p. 25-6.

National geographic magazine, Mar., 1922.—Hunting the chaulmoogra tree, by J. F. Rock, p. 243-76; Fighting insects with airplanes, by C. R. Neillie and J. S. Houser, p. 333-8.

Organized farming, Feb., 1922.—Calf crop increases on the Jornado, by E. W. Nelson, p. 1-2, 21.

Outlook, Feb. 1, 1922.—Alaska: the last of the frontier, by W. B. Greeley, p. 180-3.

Phytopathology, Dec., 1921.—Control of stem girdle of spruce transplants caused by excessive heat, by C. F. Korstian and N. J. Fetherolf, p. 485-90.

Popular mechanics, Mar., 1922.—Holder for transplanting sapling trees safely, p. 415; Popularity of myrtle wood reduces limited supply, p. 426.

Popular mechanics, Apr., 1922.—New tree-felling machine has motor-driven saw, p. 508; Logging in South India with lots of men and animals but little machinery, p. 526-7; Forest rangers adopt gasoline speeder, p. 566; Historic old elm saved by concrete filling, p. 593.

Popular science monthly, Nov., 1921.—Foresters test spark-arresters for locomotives, p. 58; Banyan-tree spreads 800 feet, p. 65.

Queensland agricultural journal, Feb., 1922.—Flowering trees of Brisbane botanic garden: Poinciana regia, by E. W. Beck, p. 68-9; Queensland trees: 8. Opossum wood, by C. T. White, p. 72-3.

Scientific American, Jan., 1922.—Lessening lumber losses, by G. H. Dacy, p. 42-3.

South Africa—Dept. of agriculture. Journal, Feb., 1922.—The propagation of trees from seed, by C. E. Legat, p. 161-72.

South African journal of industry, Jan., 1922.—Timber supplies and industrial progress, by K. A. Carlson, p. 11-18.

U. S.—Weather bureau. Monthly weather review, Dec., 1921.—Streamflow at Wagon Wheel Gap, Colo., by C. G. Bates and A. J. Henry, p. 637-50.

Wisconsin conservationist, Jan., 1922.—Timber for the state, by C. L. Harrington, p. 9-10.

Trade journals and commerce reports

American lumberman, Mar. 4, 1922.—Eastern lumberman speaks to forestry students on the merchandising of lumber, by C. Hill, p. 54-5.

Barrel and box, Feb., 1922.—Folding boxes and crates, p. 38-9.

Canada lumberman, Mar. 1, 1922.—Progress in fire retardent treatment of Canadian woods, by J. H. Coderre, p. 44-5; Quebec awakens to need of more conservation, p. 47-8.

Canada lumberman, Mar. 15, 1922.—The record of British Columbia lumber in statistical shape, by H. C. Copeland, p. 55; The lumbering industry of Canada in statistical summary, p. 60-1, 67-70; Importance of proper kiln drying facilities, by K. Redman, p. 75-6.

Commerce monthly, Apr., 1922.—Charcoal and related products, p. 23-5.

Engineering news-record, Mar. 2, 1922.—Controlling a mountain torrent in Switzerland, by K. Haller, p. 354-6.

Hardwood record, Mar. 10, 1922.—Dimension stock, by W. A. Babbitt, p. 23, 26; Kiln drying gum lumber, by C. J. M., p. 24-5, 27.

Hardwood record, Mar. 25, 1922.—Some wood stains and their causes, p. 17-19.

Journal of electricity, Feb. 15, 1922.—Airplane forest patrol makes good western record, p. 157.

Lumber, Mar. 10, 1922.—The woods of commerce: the flowering dogwood or cornel, by C. D. Mell, p. 12-13.

Lumber, Mar. 24, 1922.—The woods of commerce: beech, by C. D. Mell, p. 10.

Lumber and veneer consumer, Feb. 28, 1922.—Characteristics and uses of tamarack, p. 15-17; Among lumber consuming industries: proper kiln drying one of first essentials, p. 18-20.

Lumber world review, Feb. 25, 1922.—A few observations on forestry in Germany, by R. S. Hosmer, p. 29-33; Fourth annual session, Southern lumber congress, p. 39-53; Forestry problem of southern Appalachian and southern states, by J. H. Pratt, p. 40-1; Progress of forestry in North Carolina, by J. S. Holmes, p. 41-2; Forestry as practiced on the Arkansas national forest, by W. E. White, p. 42; A few fundamentals in forestry, by F. Roth, p. 43; The taxation of southern forest lands, by H. E. Hardtner, p. 43-4; A review of forest fires in the south, by J. A. Mitchell, p. 44-5; Steps in fire control for Louisiana, by V. H. Sonderegger, p. 45-6; Reforestation, soil erosion, and flood control in the Yazoo drainage basin, by E. N. Lowe, p. 47-8; Range fires in the longleaf pine belt, by S. W. Greene, p. 48; Causes of forest devastation and their elimination, by E. F. McCarthy, p. 49; Minimum requirements for continuous reproduction in southern Appalachian region, by E. H. Frothingham, p. 49-50; Tentative minimum requirements for the coastal plain, by R. D. Forbes, p. 50-1.

Lumber world review, Mar. 10, 1922.—The house that was built upon the sand, by H. H. Chapman, p. 34-5.

Lumber world review, Mar. 25, 1922.—Some features of forestry in France, by R. S. Hosmer, p. 29-32.

New York lumber trade journal, Mar. 15, 1922.—Introducing new tropical American hardwoods, by C. D. Mell, p. 27; The airplane and the forest, by G. F. Swenson, p. 42.

Paper, Jan. 18, 1922.—Paper work of the Bureau of standards, p. 12-15, 20.

Paper, Jan. 25, 1922.—Forest products laboratory opportunities, p. 7-9.

Paper, Feb. 15, 1922.—Jack pine pulped by sulphite process, by M. Nielson, p. 7-10.

Paper, Feb. 22, 1922.—Jack pine for newsprint paper, p. 16-17.

Paper, Mar. 1, 1922.—Papermaking in Argentina, p. 11, 18.

Paper, Mar. 15, 1922.—Reclamation process for yellow pine, by J. H. Wallace, p. 9-11.

Paper industry, Mar., 1922.—Elimination of ground-wood mill waste, by R. K. Pratt, p. 1673-9.

Paper mill, Feb. 25, 1922.—Finnish paper industry, by G. R. Snellman, p. 16.

Railway maintenance engineer, Mar., 1922.—Union Pacific builds tie treating plant, p. 97-8.

Savannah naval stores review, Mar. 18, 1922.—More about the possibilities for naval stores farming in Mexico, by E. Stein, p. 10, 27.

Savannah naval stores review, Mar. 25, 1922.—Lumber and naval stores conditions in Georgia, by H. S. Graves, p. 10, 27.

Southern lumber journal, Mar. 1, 1922.—Treated wood in home building, by O. W. Severence, p. 48, 50; Lumber drying by vacuum, by O. E. Jacobs, p. 49-50.

Southern lumber journal, Mar. 15, 1922.—Timber miners or timber farmers, by E. Richards, p. 31, 52; Naval stores from resinous woods, by W. B. Harper, p. 36-7; Growing need of preservation of mine timber, by R. R. Hornor, p. 40-2.

Southern lumberman, Feb. 25, 1922.—Saws: their care and upkeep, by A. Hills, p. 46-8.

Southern lumberman, Mar. 4, 1922.—Profits from pine stumps and waste, by J. F. Carter, p. 43-4.

Southern lumberman, Mar. 25, 1922.—The menace of idle land, by W. B. Greeley, p. 45-6.

Timber trades journal, Feb. 11, 1922.—The timber industry of Sweden, by C. W. Cedervall, p. 332-7; Afforestation and taxtion, by E. D. Malcolm, p. 366; Aeroplane materials, by W. T. Blake, p. 375.

Timber trades journal, Feb. 18, 1922.—British Columbia: its timber resources, by W. Turnbull, p. 454.

Timber trades journal, Feb. 25, 1922.—Furniture woods: English and foreign, by P. A. Wells, p. 467-8; Timber industry in far eastern Asia, p. 503; Timber supplies and industrial progress, p. XXXIII, XXXV.

Timber trades journal, Mar. 11, 1922.—The failure of timber supplies in Soviet Russia, p. 595; The manufacture of wood pulp, by R. W. Sindall, p. 600; Finnish timber industry, p. 602; The timbers of Paraguay, by F. W. Paris, p. 648-9; Where the corks come from, p. 649.

Timberman, Mar., 1922.—White pine blister rust, by J. V. Hofmann, p. 33-5; Comparative freight charges, p. 39; National forests of the continental divide, by A. S. Peck, p. 46; Proposed method of fire prevention, by J. G. Lewis, p. 48L, 48N; Commercial hardwoods of the Philippines, p. 48P; General theory of kiln drying lumber, by H. S. Newins, p. 49-53; Undeveloped timber section of Arizona: over one billion feet contained in the 300,000-acre area, p. 114, 117; Wood block pavement in England, by W. J. Blackmur, p. 117; The Russian wood-working industry, by W. Jacobs, p. 126; Simple principles involved in kiln operation, by C. W. Gould, p. 130-2; Perpetual forest industry in Oregon, by G. W. Peavy, p. 139; Lumber standardization interest growing, p. 142; Water resistant glues, p. 142.

U. S. commerce report, Feb. 27, 1922.—Lumber export trade of Sweden, 1921, p. 510; Lumber demand in Japan, by H. A. Butts, p. 510-11.

U. S. commerce report, Mar. 6, 1922.—Market for American railway ties in United Kingdom, by A. V. Dye, p. 552-3; Market for box shooks in Sonora, Mexico, by B. F. Jost, p. 553; West African market for southern pine and hardwoods, by R. P. Clark, p. 553-4.

U. S. commerce report, Mar. 13, 1922.—U. S. lumber exports for January, p. 614; Market in Chile for wood for making shoe heels, by R. S. Smith, p. 614-15; Market for ready-cut houses in Peru, by W. E. Dunn, p. 615.

U. S. commerce report, Mar. 27, 1922.—Lumber and timber trade of the Netherlands, by G. E. Anderson, p. 753-4; Exports of lumber from Finland, p. 754.

U. S. commerce report, Mar. 20, 1922.—Timber trade of the United Kingdom, by A. V. Dye, p. 686-7; Lumber exports from Norway during 1920 and 1921, p. 687-8; Sawmills in Latvia, by J. P. Hurley, p. 688.

West Coast lumberman, Mar. 15, 1922.—Japan used over 800,000,000 feet of lumber during 1921, by H. Muro, p. 22; How to properly pile lumber for air seasoning, by J. W. Martin, p. 27, 46; Douglas fir for washer tubs, by W. M. Tait, p. 36-7; Are present slash disposal laws adequate, by F. E. Pape, p. 38.

Wood-worker, Mar., 1922.—Manufacture of wooden rulers, by A. Williams, p. 48-9.

Forest journals

American forestry, Mar., 1922.—Logging mahogany in tropical West Africa, by V. B. Paine, p. 131-41; The magic cup, by A. N. Pack, p. 142-4; The sycamores, by J. S. Illick, p. 145-50; Wood for professional and scientific instruments, by H. Maxwell, p. 151-8; Bird guardians of the trees, by E. H. Forbush, p. 159-64; Annual meeting of the American forestry association, p. 169-72; Pine roots and potatoes, by A. N. Pack, p. 173, 178; With the graphlex in Chelan, by C. J. Blanchard, p. 175-8; Col. Graves on the Snell bill, p. 179-80; Street shade trees, before and after, by W. R. Mattoon, p. 181; Hickory in demand, p. 185.

American forestry, Apr., 1922.—A seven hundred year logging company, by A. N. Pack, p. 195-9; Airplanes for forest work, by E. Wilson, p. 199; The fight for Alaska's forests, p. 200-8; Need of a land policy for northern "cut-overs," p. 208-9; Simple forest conservation, by A. V. S. Pulling, p. 211-17; Forestry in Connecticut, by T. S. Woolsey, Jr., p. 218, 243; Producing the recreation commodity, by A. H. Carhart, p. 219-24; Do not let the curbsetter ruin your trees, by S. N. Baxter, p. 232-4; Novel trees and forest products, by S. J. Record, p. 235-7; South African forests, p. 237; Transplating, by F. L. Mulford, p. 238-43; Gifford Pinchot on the Snell bill, p. 244-5.

Australian forestry journal, Jan., 1922. —Tarrietia argyrodendron, by W. R. Petrie, p. 9-10; Plantations in New South Wales, by A. Helms, p. 11-12; The Christmas tree, p. 18-20; Hemlock sole leather, an historical American product, p. 20-1; Canada saving forests: keeping up the paper supply, p. 21-3.

Canadian forestry magazine, Jan., 1922. —Remarkable development of tree planting on prairie, p. 559-61; Extensive planting plan to save Ontario's pine supply, by E. J. Zavitz, p. 564-6, 594-5; The evolution of B. C.'s forest industry, by W. Turnbull, p. 566-7, 591; Birds guardians of our forests, by H. Lloyd, p. 567-9, 590; The actual cost of aerial cruising, by R. Leckie, p. 572-4; With a Canadian observer in Scandinavia, by E. Beck, p. 575-80; Growing trees for the prairie market, p. 581-2; Wireless a great power in rapid action, by P. G. Redington, p. 592.

Canadian forestry journal, Feb., 1922.—Forest fires the plague of the fur trade, p. 603-4; Ontario's forests as a continuous crop, by E. C. Drury, p. 605-7; Reclothing the prairies with trees, by A. Mitchell, p. 609-12; Another "useless" wood turned to account, p. 612; Canada must take out a timber insurance policy, by R. O. Sweezey, p. 614-15; Dusting trees from an airplane, p. 616; How planes help with fire fighting, by P. G. Redington, p. 617; This is the year's story of your association, the Canadian forestry association, p. 618-32; League of boys for forest protection, by A. de H. Smith, p. 641-2; Shelter belts and wind breaks, p. 644-5.

Centralblatt für das gesamte forstwesen, Mar.-Apr., 1922.—Alpenhumus: das gesetz seiner bildung, by L. Tschermak, p. 65-75; Untersuchungen über die grunästung der fichte, p. 101-4.

Forstwissenschaftliches centralblatt, Jan., 1922.—Neuere verjüngungsverfahren, by Rubner, p. 1-23; Die streufauna, by A. Escherich, p. 23-9.

Indian forester, Jan., 1922.—A dissertation upon forest finance, by R. Bourne, p. 1-14; The conversion of coppice and coppice-with-standards to high forest, by F. W. Champion, p. 15-21; Mortality of sal in Buxa division, Bengal, by A. K. Glasson, p. 22-31; Notes upon Santalum album in the Chittoor district of the Madras Presidency, by C. E. C. Fischer, p. 32-4; Note on the relative strength of spruce red-wood and spruce white-wood (Picea morinda), p. 34-42.

Journal forestier suisse, Mar., 1922.—Quelques impressions sur le Portugal forestier, by Knuchel, p. 41-5; Evaporation de l'eau à l'air libre, à Montcherand, by M. Moreillon, p. 52-6.

Journal of forestry, Jan., 1922.—The forest situation in Canada, by B. E. Fernow, p. 1-2; Address of welcome, by B. Bowman, p. 3; Timber administration of the Dominion forest service, by T. W. Dwight, p. 4-9; Status of forestry in western Canada, by W. N. Millar, p. 10-17; Reforestation in Ontario, by E. J. Zavitz, p. 18-24; The forests of Quebec, by G. C. Piché, p. 25-43; Forestry problems in British Columbia, by P. C. Caverhill, p. 44-53; Forestry administration in New Brunswick, by G. H. Prince, p. 54-61; Research work of the Dominion forest service, by W. G. Wright, p. 62-6; Some problems of forest pathology in Ontario: needle blight of white pine, by J. H. Faull, p. 67-70; American trees in Scotland, by J. Sutherland, p. 71-4.

Journal of the Arnold Arboretum, Apr., 1921.—A list of the trees of Louisiana, by R. S. Cocks, p. 204-16; The forest flora of the Ozark region, by E. J. Palmer, p. 216-32; Notes from Australasia: 2. The New Zealand forests, by E. H. Wilson, p. 232-6.

North woods, Nov., 1921.—Horse patrol, by O. R. Levin, p. 5-9; The walnut as a road side tree, by P. O. Anderson, p. 10-13.

North woods, Dec., 1921.—Woodlots and shelterbelts, by P. O. Anderson, p. 5-10.

Revue des eaux et forêts, Jan., 1922.—Le cyprès chauve dans les marais des bouches du Rhone, by P. Bauby, p. 1-10; Les tarifs de chemin de fer pour les bois, by A. Arnould, p. 11-17.

Schweizerische zeitschrift für forstwesen, Mar., 1922.—Die bekämpfung des borkenkäfers in den kantonen Aargau und Zürich zu anfang des 19. jahrhunderts, by L. Weiss, p. 70-80; Untersuchungen über das verhältnis des stockdurchmessers zum brusthöhendurchmesser für fichte, tanne, föhre und buche (gebirge), by M. Oechslin, p. 80-84; Forstlicher preisabbau und defizitwirtschaft, by A. Brunnhofer, p. 84-6; Der windfall von 1911 in den waldungen der Burgermeinde Biel, p. 86-9.

Yale forest school news, Apr., 1922.—Accomplishment through education, by S. N. Spring, p. 24-7; Growing pine for profit on fifty thousand acres in Louisiana, by H. E. Hardtner, p. 28.

NOTES

A Nursery for Reforesting Rocky Lands

There is here outlined an argument in favor of some experienced and scientific forester this year starting an experiment along the lines suggested to see how such a tree nursery would compare with the usual forest nursery. A fraction of an acre would perhaps be sufficient for an adequate demonstration.

In view of the great difficulty of successfully setting out trees on rocky lands and in view of the extent of rocky soils in various parts of the East, it would seem that a nursery as described below, if it would work, might find a place in a state's forestry system.

Such a nursery should be located immediately next to a large moss swamp with a contiguous solid land level enough for nursery purposes and the swamp selected should be in a mountainous territory of rocky character. The contiguous solid land might be hard pan or any soil that would roll smooth and hard. Then the moss could be hauled out of the swamp and spread over the nursery site to a depth of two inches. Perhaps there should be an admixture of good soil. This would be approximately 250 cubic yards of moss to the acre and if two men with a team could haul out ten loads of two cubic yards each a day they could haul out enough to cover two acres in one month. Sphagnum moss in swamps is often two feet thick and could be pitched off the loads like manure, or perhaps a regular manure spreader would be more feasible. Then the moss should be more carefully worked over so that it was approximately two inches deep throughout. Then when it was in a proper state of preparation the seeds, presumably pine, would be planted practically the same as in a regular nursery. And the seedlings could be left undisturbed until they were ready to be placed in the area to be reforested. When that time came the moss could be cut like a carpet into yard squares and one layer laid on top of another until moss was three feet each way when it might be baled and shipped by train. Or it might be laid on a truck or hayrack and taken to the place where the plantation was to be made. When there, one of these moss squares could be readily separated into fragments of the proper

size which would be laid down six feet by six feet or to any other desired spacing. Let us assume that a piece of the moss four inches by four inches square contained one or more seedlings, then there would be 1,458 pieces of moss of that size in a bale of moss containing one cubic yard. One cubic yard should be enough to provide for one acre.

Probably all foresters have at some time seen sphagnum moss swamps lying in conjunction with rocky upland, perhaps where the mountain was solid rock. And doubtless they have been impressed at the luxuriant growth of the evergreens in those places where the moss has grown from the swamp and covered up some of the dry rock near by. Also they have doubtless seen numerous places in the woods in mountainous country where the smooth solid rock of a generation ago has mossed in and where now a luxuriant thicket of evergreens is started. Perhaps they have picked up some tuft of moss of only a few square inches that contained a thrifty young pine and set it down to grow in another place. If so and if they have watched it grow they know how ideal for transplanting purposes is a pine growing in such a piece of moss. A tree with such moss can be set down at any time in the summer on hot bare rock and never appear to be disturbed. If the rock is not so steep that the moss will slide or blow away the tree will live. It is true that a few cases of survival may be considered accidental, but a few such cases justify the experiment of seeing how many trees would live out of one thousand. Probably the more swamp-land borders one has seen the more he will have faith in such a nursery as here contemplated.

In addition to very rocky soil there is another class of location where this system would appear more feasible than the regular method of transplating. Such a location is where the transplants will have to fight a vigorous sprout growth. Let us assume a case where experience has demonstrated that two-year, three-year or four-year transplants will be crowded out unless cutting back the sprouts is performed once or twice after the plantation is started. In such a case instead of setting out pine three to six inches high, that is, two to four years old, why could not pines five or six years old, or twelve to twenty-four inches high be set out in the fall with moss ten or twelve inches square to each tree. The winter snows should pack the moss firmly against the ground and when the next year's growing season started the pine should have a fine chance to beat the scrub sprouts. For such large transplanting stock, the nursery should have smooth bare rock on which

the moss would be spread to a depth of two or two and one-half inches, perhaps with a slight mixture of good soil. In that case none of the roots could penetrate to any depth and none would be lost when the moss carpet containing the trees was lifted. Of course such transplants would cost more than smaller ones, but one to three years should be saved in getting the forest crop and it should be unnecessary to cut back the scrub sprouts after the transplanting.

Another field where this might be tried is in the case of the private nurseries. There are many estates of wealthy men where there are exposed ledges and rocky soils on which the owner would like to have growing a few evergreens. But digging a hole is out of the question and bringing a load of dirt is expensive. If he could buy from a nurseryman a handsome evergreen six feet high that had grown in moss four inches deep and three feet each way located on smooth solid rock so that when the tree with the moss was taken up all the rootlets would come too, he would be getting a tree the transplanting of which would be practically fool-proof.

Now the question arises as to how such a nursery would compare with the usual nurseries for the usual plantations. Its location would be more restricted yet there are a great number of moss swamps of large size in the northeastern states. When the seed bed had been prepared and planted it could be left alone until the plantation was to be made. There would be no need of transplanting from one bed to another. In setting out there would be no heeling in and no puddling. There should be a very high survival. One man should be able to handle the work as advantageously as two or three men. Also as moss holds moisture so well it should be possible to transplant at any time in the spring, summer or fall. The hose could be turned on the moss just before a truck load left the nursery. And if the location was smooth solid rock it should be feasible to produce five, six or seven year stock for difficult places where sprout growth was a menace or for estates where the owner desired his land to take on a forest appearance as soon as possible.

What would make such a nursery impracticable?

M. S. Howard.

Forest Taxation in Sweden [1]

A new law relating to forest taxation will become effective in Sweden in 1922. The greatest weakness in the old law lay in the inequality in rating values for individual holdings. The new law has, therefore, stressed the point of equal rating all over the country.

Valuation of forest land and standing timber will be on the basis of yield only in that the reduced net income is capitalized at a 6 per cent interest rate. The reduced means that net profit which remains after the owner has paid taxes, cost of roads, cultural measures, etc.

The forest value is obtained in that the reduced net income is divided by 0.06. The forest value (capitalized) in normal times is fixed at 16.67 times the calculated reduced net yield. Of this three years' yield, 18 per cent, is considered as the value of the forest land, while the rest, 13.67 years' yield, or 82 per cent, is the value of the stand itself.

In figuring the normal yield which is used as a basis for arriving at the value of the forest land, no consideration is given the present productiveness. The value of the forest itself, on the other hand, is fixed according to the present stand, its conditions, and that yield which this stand can be expected to give if continued to be used in a rational manner.

If the forest is made up of representative age classes, and gives a sustained yield which is considered normal, its relative weight in a rating scale is 1.0, and in this case the stand is valued at 13.67 normal yield. If the forest is not up to normal, which is commonly the case, the stand value is designated in decimals parts of 1.0. If its rating is 0.5, 0.6, or 0.7, etc., the values given in the rating tables, which are based on 1.0 or normal, are reduced by these figures. If, on the other hand, the forest conditions and yield are unusually good, as when the forest consists of much mature timber which contains high-grade material, the correction factors for the values in the table are 1.1, 1.2, 1.3, etc.

In fixing the relative rating, it must be remembered that the fundamental reason for this method of taxation is not to assess the timber without regard to its density, but according to the value of the yield, namely, that capitalized at 6 per cent. If the forest contains mostly young immature stands, the valuation will be small although the quantity of material may be considerable.

[1] Translation from Tidsskrift for Skogbrug, Vol. 29, pages 308-316, 1921.

Average stumpage value, m³	Normal yield of the forest per hectare in cubic meters								
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
	Land and stand value at normal stocking, crowns per hectare								
6—Costly operation, low value of products.	7	13	20	27	34	40	47	54	Land value
	31	62	90	123	154	185	215	246	Stand value
7—	8	16	24	31	39	47	55	63	Land value
	36	72	108	144	179	215	251	287	Stand value
8—Medium cost operation, yield.	9	18	27	36	45	54	63	72	Land value
	41	82	123	164	205	246	287	328	Stand value
9—	10	20	30	40	51	61	71	81	Land value
	46	92	138	185	231	277	323	369	Stand value
10—Valuable material and favorable operating conditions.	11	22	34	45	56	67	79	90	Land value
	51	103	154	205	256	308	359	410	Stand value
11—	12	25	37	49	62	74	87	99	Land value
	56	113	169	226	282	338	395	451	Stand value
	Cubic meter per hectare								
	17	33	50	67	83	100	117	133	In 100-year rotation and 3 per cent growth the following quantity per hectare is necessary in order to have full (normal) yield.

They do not split hairs in determining what constitutes a normal forest, for the main reason in using this designation is in having some basis on which to hang this rating system. No rigid standards are proposed by which to test or compare the forests under valuation.

Since the assessment is based on the productivity of the forest only the area of productive forests and not its market or other values is considered. Grazing areas, swamps, rock surfaces, and water are not included. These are assessed according to their sale value. The areas of each holding of forest, swamp, rock, etc., must be reported by the owner. If a part of the forest is set aside as woodlot or devoted to supply the needs of the owner for wood or material, it is not to be included.

Yield is expressed in whole or half cubic meters of material per hectare, including bark. The monetary value is calculated according to the average net prices in effect locally for similar operations from 1912-1919, or according to the company's own books. Areas set aside for private use, as woodlots, etc., are also appraised but separately and according to local rates.

Deductions for cost of administration, taxes, and improvements, are limited to 25 per cent, but may, in the case of protection forests, run up to 50 per cent of the net profit. The latter must, according to law, be administered in such a way that their expenses are proportionately higher than other forests.

Tables have been prepared setting forth values of the stand and of the land under poor, medium, and good operating conditions, and prices for forests of different rating. The values in the tables are used as soon as the assessor knows the quantity of yield price of product and expenses. Example: If the yield is 2 m^3 per hectare per year, and the net value per m^3 is 9.00 crowns the land value will be 40.00 crowns and the stand value 185.00 crowns per hectare. If the forest is only 0.7 of the normal the stand value is 0.7 times 185 or 129.50 crowns.

The chief function of appraisers and assessors is thus to determine in what degree the yield of each holding varies from the mean for that district in respect to quality, price, etc. The values they set must fall within the limits fixed in the tables.

It goes without saying that the assessors, in view of the short time before the reports are due, could not go into great detail or refinement in the calculations, both because of the volume of work and the lack of field data.

The new forest taxation law is considered a long stride ahead in this difficult field of economics. Foresters have been influential in framing it and they will everywhere and at all times have a strong hand in applying it.

J. A. Larsen.

Studies in Forest Tree Seeds; Seed Storage and Chemical Treatment

Many of the studies of seed storage have to do with the results obtained by holding the seed in containers of different kinds, such as sealed glass bottles, muslin bags, paper bags, etc. There has been a wide difference in the results secured, which has been attributed usually either to the location in which the seed is stored or to the container. It is believed, however, that there is an additional factor which so far has been overlooked, namely, that of the presence of minute organisms or fungi which attack the seed itself.

In order to ascertain just to what extent these organisms may destroy the vitality of the seed, small bottles were filled with western yellow pine seed in 1915 and kept until 1921, when they were sown and the results noted. One sample was kept as a check while each of the other five were treated in various ways before being stored away. At first the seed was kept in the open bottle with only a piece of paper tied across the top, but later, moving necessitated sealing the bottle with a cork and paraffine, making it impermeable to air and moisture. No attempt was made to keep the seed at a constant air temperature, the seed being stored in a cellar part of the time, on an open shelf, while for a considerable portion of the intervening time the seed was stored in a box among other things at ordinary room temperatures.

One lot of this seed was soaked in formaldehyde for a period of 6 hours and then dried for 24 hours on a screen before being bottled. One lot of seed was given a live steam bath at a pressure of about three atmospheres for nearly half an hour. One lot each was soaked in dilute hydrochloric and sulphuric acid for 4 hours and then dried for 24 hours. Another lot of seed was soaked in a strong solution of copper sulphate for 6 hours and then dried for 24 hours before storing.

Seeds were sown in cans at the same depth and in sand from the same place and kept in a fairly warm situation. The soil moisture was maintained constantly at 15 per cent in conformity with previous experience by repeated weighings and the addition of such water as was necessary.

The results of this test are given in the following table, which shows that the seeds which had not been treated gave the lowest germination per cent and took the longest time to secure total germination, while seeds which had been soaked in formaldehyde gave the highest germination; the quickest germination being secured from those treated with hydrochloric acid.

Results of Seed Treatment.

Treatment	Number of days required to secure germination				Final germination per cent
	25 per cent	50 per cent	75 per cent	100 per cent	
Check	44	59	87	144	43.5
Formaldehyde	54	61	78	109	87.0
Hydrochloric acid	39	51	74	98	79.0
Sulphuric acid	28	53	83	108	81.5
Copper sulphate	31	57	94	125	63.0
Live steam	36	59	101	138	31.5

From the low germination secured from live steam it is presumed that the temperatures became too high for the seed and the germs were killed by the heat itself rather than by the subsequent treatment. The difference between the check lot of seed and those treated with some preservative shows that the presence of fungi or microorganisms are perhaps of as great, if not of greater, importance than the method by which the seed is stored itself. It is believed that the seeds once free from all spores would not readily become reinfected, while if the treatment was continued long enough it would reach the spores contained inside the dead seeds which spread from seed to seed.

Recent investigations of seed fungi, undertaken by Dr. Meinecke, have shown that forest seeds may contain at the time of their collection a large number of spores of various fungi which absolutely destroy the vitality of the seed in a very short time. They show furthermore that seeds infected with these fungi may contaminate others very readily and these spread rapidly from seed to seed when placed in close contact. It appears therefore that it is advisable before storing seed to treat this material with some form of preservative. Apparently there is very little choice between the materials used, though formaldehyde has given the best results. Additional studies are required to determine for each species the proper preservative to be used and the degree of strength of the solution and time of soaking and subsequent drying before anything definite as to actual practice can be given. In the meantime, however, it is apparent that if seed is to be kept for any length of time it should first be given a preservative bath which would aid in storage by killing the spores or organisms responsible for loss of seed.

E. N. Munns.

Influence of Locust on the Growth of Catalpa

In 1908 plantations of black locust and hardy catalpa were made on the College Farm at State College, Pa. These plantations lie side by side covering about four acres, the catalpa lying to the southeast of the locust. One-year-old seedlings were used, spaced 5 feet by 5 feet. Between the locust and catalpa were planted three rows of green ash, making the first row of catalpa 20 feet from the locust planting.

The situation is upland with a gentle slope toward the southeast. The soil is Hagerstown silty loam. The natural tree vegetation on similar and adjacent sites is white, black, and scarlet oaks, hickory, pitch pine, and some white pine.

The site proved favorable to the growth of the black locust. After 13 years the trees average 4.8 inches in d. b. h. and 35 to 40 feet in height. The catalpa, on the other hand, did not thrive. In 1910 a report was made to the Agricultural Experiment Station as follows: "This planting shows that catalpa is a failure on this situation." In 1913 after 5 years of growth it was reported: "The diameter of the catalpa trees vary from three-fourths to 1½ inches; many trees have not yet reached a height of 4.5 feet." It was recommended that the catalpa plantation be abandoned and the land planted to other species of trees. This recommendation, however, was not carried out. The stand has grown naturally since then.

An examination of this catalpa plantation made in the spring of 1921 shows a marked contrast between the growth of catalpa trees in the first few rows from the locust plantation and the growth of trees at a distance.

The average d. b. h. and average height of trees in the first nine rows of the catalpa is as follows:

	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth
Average d. b. h.	3.3	3.5	2.7	2.1	1.4	1.9	1.1	.9	.7
Average height	26.8	24.6	20.5	15.2	10	11.3	7.6	6.5	.5

Growing among the catalpa trees for a distance of 40 feet are black locust trees started as seedlings and as suckers. Between the catalpa and black locust plantations the space originally planted to green ash is completely occupied by black locust, some of the trees being 4 inches in diameter. The green ash trees have been completely suppressed.

Within the catalpa plantation, the black locust trees diminish in size and numbers from the first row. Many dead black locust 2 to 3 feet high are observed among the catalpa trees, having developed for a year or more and then died from lack of light.

The assumption is that the black locust by adding nitrogen to the soil has influenced the growth of the catalpa.

Soil samples were taken within the locust plantation, between the first and second rows of the catalpa and between the eighth and ninth rows of catalpa. These samples were made with a soil auger to a depth of 6 inches, the humus being first removed. Fifty samples were taken in each situation.

The chemical analyses to determine nitrogen content of the soils were made by Walter Thomas, of the Agricultural Experiment Station at State College, Pa.

Description	Loss in air drying, per cent	Hygroscopic moisture in air-dry soil, per cent.	Nitrogen in water free soil, per cent.	
Locust	21.1	1.86	.103 .101 .102	.102
Large catalpa.....	20.4	2.41	.096 .098 .099	.098
Small catalpa.....	19.7	2.08	.087 .090 .089	.089

This soil analysis shows a difference of only .004 per cent of nitrogen between the soil in the locust plantation and the large catalpa in the first and second rows. It shows a difference of .009 per cent between the soil in the small catalpa in the eighth and ninth rows and the large catalpa.

Had the soil borings been 3 to 4 inches in depth instead of 6 inches, it is believed these differences would have been more marked.

This observation is of interest in indicating lines of experimental plantings that might be made to determine the influence certain trees have on the growth of other trees.

J. A. FERGUSON.

The Tall Eucalyptus

We see these trees well and deeply rooted, growing to great heights, which seems out of proportion to what we know of other trees.

Now, when one prunes or trims a tree, removing its upward shooting and vigorous branches, while the side ones are allowed to grow, there results a broadly spreading flat-topped tree, such as we find in fruit orchards where one is anxious to keep the fruit near the ground, and so accessible for picking at harvest time. On the other hand, even a tree of spreading growth can be made taller by cutting back the side branches, while the leading upward-growing ones shoot up.

Now, this is what by a certain natural process happens to the eucalyptus tree, especially when two or three stems shoot up together. In ordinary weather they grow peacefully with space sufficient for all, but when a storm-wind comes, the conditions radically change. The elastic branches with their clumps of foliage wave in the wind, rocking back and forth, and so come in contact with one another. It can be seen that interfering branches are broken and foliage is stripped, due to these distorted and unusual contacts. Here a smaller or even a larger limb is broken, and where the foliage is clubbed together this is gradually torn or rubbed away. On a stormy day one sees an occasional branch, spray of leaves, bits of bark, fly from the parent stem and carried far to the ground, so that after such a storm the ground to the leeward is strewn with leaves, bark, and branches of various sizes. In other words, the tree has been roughly and vigorously trimmed. The central and higher branches that escape damage resume vigorous and rapid growth, helped by the fact that the sap, intended to nourish the side branches (now removed), has gone into the central topmost boughs. Perhaps two or three times in a year such storm-winds arise to thus produce this prunning effect. Can one wonder that the untouched higher terminals so rapidly shoot upward?

I have in view at this moment a eucalyptus tree, 110 feet high, its exposed branches moving back and forth for the space of 10 to 20 feet, the leaf clumps spilling the wind as they yield before it. I have not seen these prostrated as in the case with pines and other evergreens or even like the deciduous trees caught in a storm when in full foliage. The eucalyptus trunk widens or expands where it enters the ground and is buttressed or tied by the spreading roots. In a dry climate, as in southern California, with an annual seasonal precipitation of per-

haps 15 inches, it seems to be unaffected by drought, due, as one may say, to its deep roots. It carries its leaves the year round, shedding them gradually, so that one may see them accumulating upon the ground year by year.

One finds the eucalyptus has a wide habitat, though a dry climate tree. Of Australian origin, one finds them both in subtropical and in tropical regions. I have seen them flourishing in the British Guiana tropics, and they grow to the northward of San Francisco on the west coast.

One can draw the general conclusion that nature, with the aid of climatic winds, may develop plant-life to suit environment in unthought-of directions; and the study of the effect of strong winds on plants will develop some novel ideas as to the effects of such violent action.

LEONARD S. AUSTIN.

WORMY TIMBER COSTLY

A report just received by the Office of State Entomologist, State Museum, Albany, N. Y., calls attention to serious injury in a new sulphuric acid factory built at a cost of 3,500,000 marks early in 1921 near Saarau, Silesia. The trouble was caused by the use of timbers infested by horn-tail borers. The latter issued from the wood and perforated the lead floor plates, causing a loss of 100,000 marks. Horn-tail larvæ live exclusively or nearly so in decaying or dead wood, consequently the use of such timbers may be followed by unexpectedly serious injury, since the insects will emerge if possible. Such timber is more subject to decay. It is not even safe to utilize it for box boards. Some years ago our attention was called to rolls of cloth which had been perforated by one of our native horn-tails after escaping from the wood of the containing box.

The high cost of lumber has been followed by somewhat indiscriminate use of materials, and in several cases out attention has been called to powder-post infestations in the trim of city apartments due to the fact that sapwood was generally utilized and presumably there had been less care exercised than usual to prevent infestation.

E. P. FELT.

SOCIETY AFFAIRS

The following have been elected to membership in the Society, effective March 23, 1922:

SENIOR MEMBERS.

Leon M. Ellis, Wellington, New Zealand
J. J. Fritz, Gorham, N. H.
C. J. Humphrey, Madison, Wis.
John C. Roak, Kanab, Utah
Harold B. Shepard, Bangor, Me.
A. C. Silvius, Pottsville, Pa.
V. H. Sonderegger, New Orleans, La.
D. D. Wood, Sandakan, British North Borneo.

MEMBERS.

Earl M. Blair, Weed, Calif.
S. A. Boulden, Cleveland, Calif.
S. C. Brayton, Madison, Wisc.
P. P. Clement, Bangor, Me.
Samuel Corbin, Baltimore, Md.
F. P. Cunningham, Porterville, Calif.
George Drolet, Tuscaloosa, Ala.
John S. Everitt, Sisson, Calif.
L. J. Freedman, Great Works, Me.
George M. Gowen, Northfork, Calif.
R. H. Grabow, Madison, Wisc.
L. F. Grose, Amherst, Mass.
Warren F. Hale, Concord, N. H.
E. K. Hanley, Thomaston, Me.
C. L. Harrington, Madison, Wisc.
Frank L. Haynes, Boston, Mass.
William D. Hayes, Bangor, Me.
P. C. Heald, Wilton, N. H.
William B. Hill, Milo, Me.
Phil. R. Hussey, Bangor, Me.
Thos. J. Jones, Bishop, Calif.
Chester E. Jordan, San Francisco, Calif.
Geo. S. Kephart, Bangor, Me.
F. L. Kirby, Globe, Ariz.
R. S. Langdell, Lowell, Mass.
D. E. Lauderburn, Brunswick, Me.
L. R. Lessel, Flagstaff, Ariz.
Leo W. Meyer, San Francisco, Calif.
Howard B. Morse, Bangor, Me.
L. E. Newman, Concord, N. H.
R. B. Parmenter, Brockton, Mass.
Carl C. Perry, Newton, Mass.
J. L. Peterson, Portland, Ore.
Carl C. Pflueger, Los Baños, Laguna, P. I.
A. V. S. Pulling, Fredericton, N. B.
E. T. Savage, Bangor, Me.
Harry P. Saxton, Yreka, Calif.
Abbot B. Silva, Cleveland, Ohio
Thos. W. Sloan, Santa Barbara, Calif.
Edwin F. Smith, Placerville, Calif.
J. N. Spaeth, Petershaw, Mass.
W. H. Swanson, Madison, Wisc.
Theodore T. Swift, Safford, Ariz.
Warren P. Upham, Orono, Me.
William C. Wheeler, Bangor, Me.
H. R. Wickenden, Three Rivers, P. Q.

ASSOCIATE MEMBER.

Maxwell C. Hutchins, Boston, Mass.

The New England Section Society of American Foresters

The New England Section held its annual business meeting at the State House, Boston, on February 17, with thirty-one of the sixty members present.

Resolutions were adopted favoring a liberal appropriation for blister-rust control, a million-dollar fund for National Forest purchase, and more money for co-operative fire protection.

Professor R. T. Fisher, of the Harvard Forest School, was re-elected chairman; H. O. Cook, Chief Forester of the Massachusetts Department of Conservation, secretary; and George T. Carlisle, of Bangor, member of the executive committee.

The proposed new forest tax law of Massachusetts was explained by Mr. Reynolds; State Forester Foster, of New Hampshire, brought out some weak spots in the fire-observation-tower system; and Professor Fisher spoke on the advantages from both a silvicultural and economic standpoint of a clear-cutting system as compared with a selection forest.

The names of eleven new members were proposed to the executive council.

Salt Lake Meeting

It was voted at Toronto to hold a meeting this year in conjunction with the special summer meeting of the American Association for the Advancement of Science, which, together with the annual meeting of the Pacific Division of the Association, will be held at Salt Lake City between June 22-24.

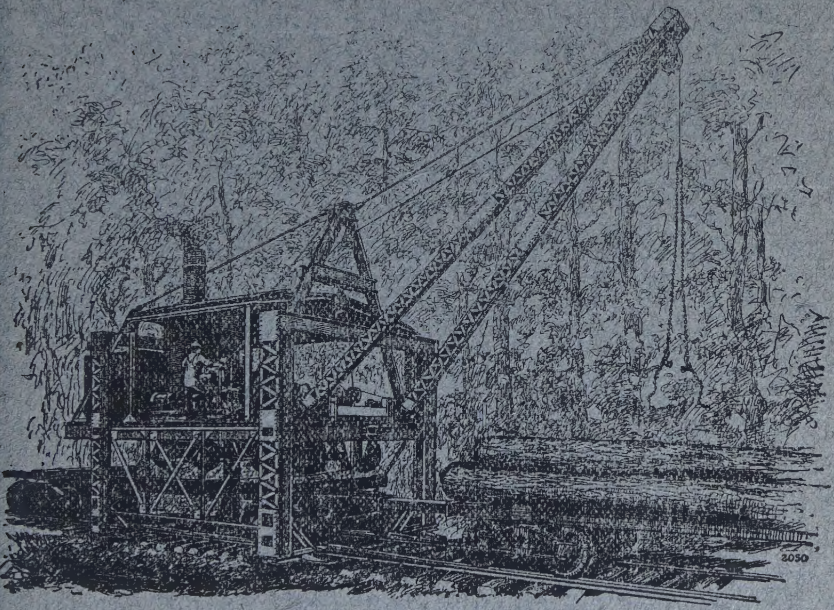
The following committee will have charge of the program and other arrangements for the meeting of the Society:

Prof. Hugo Winkenwerder, Chairman.

Edward N. Munns.

Frederick S. Baker, Secretary.

As the meeting is to be held especially for the benefit of the western members of the Society, many of whom find it impossible to attend the December meetings in the East, it is hoped that all of the western Sections may be represented both in the attendance and on the program.



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